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The New Size

TO DESIGN a new dress for a magazine involves almost as much work as making a new gown for a lady. It is not merely a matter of getting some clothing—but of getting clothing that comports with the dignity, the characteristics of the magazine or person clothed. Therefore, for some months there has been much designing, much fitting that the new dress might be worthy of the *Engineering Record*, and might not only be agreeable in itself, but be dignified and forceful. We believe that we have succeeded in carrying out our intentions. We know that we have had much grief, with type sizes and type faces, with two-column-to-the-page and three-column-to-the-page make-up. We could have put more words on a page, by using smaller type or less spacing between lines. But the page would have been less inviting—and, above all, we are writing the *Engineering Record* that it may be read, for only by the reading of it can the matter be made valuable. We trust that the paper in its new form will not fail of the welcome it received in its old dress. As we have repeatedly said of late, the paper itself, in spirit, in force, in personality, will not change. Only the dress will be different.

Ice and Water Supplies

TO MANY waterworks men who are looking forward with anxiety to the freezing of their mains this winter, ice is just ice—an annual visitor whose calls are as regular as they are unwelcome. But the man who has studied the effects of low temperatures on water realizes that the subject cannot be thus summarily dismissed. The three forms of ice—surface, frazil and anchor—have different effects, while radiation, conduction and convection, all play an important part in the abstraction of heat from water. These topics are discussed at length in a timely paper by William W. Brush, deputy chief engineer of the New York Department of Water Supply, Gas and Electricity, just published in the December number of the *Journal of the American Waterworks Association*. Mr. Brush prefaces the experiences of the New York Water Department with subaqueous mains by a brief discussion in which it is pointed out that a main laid in salt water, without earth cover, is much more liable to freeze than one in fresh water. Water from a reservoir or stream, it is stated, seldom attains a temperature below 33 deg. Fahr. If, however, the temperature be further lowered during passage through the pipe, two things may happen: An ice film may form on the in-

terior surface of the main, insulating it to some extent from further heat losses, or, if the velocity be high, frazil ice may develop to such an extent as to choke up the main completely. Mr. Brush adds some interesting information regarding the use of electric thawing. As a preparation for meeting the severe winter conditions which come in January and February a reading of Mr. Brush's article is recommended.

Review of the Year

IN CONFORMITY WITH CUSTOM, the *Engineering Record* presents in this issue a series of articles reviewing the status of those engineering problems or developments which, at the moment, seem to be of paramount interest. No attempt is made to cover every phase of civil engineering and contracting. In most fields there has been little marked progress. To attempt a review of their status would be to repeat what has already been said or what is so patent as not to need saying. The status of the engineer, success in contracting work, the prices of materials and labor are perennial questions. The progress toward professional unity, and the conditions created by the war have, however, given them an especial interest this year. The motor truck in its relation to the road, activated-sludge, federal highway aid and the engineer's relation to foreign trade are, relatively, new problems. All of them, the new and the old, are discussed in this issue by recognized leaders in their respective fields. We present the reviews with full confidence that through them the readers of the *Engineering Record* will get authoritative and far-seeing views of the various matters in question.

Pure Science and Utility

IS THE mere cataloging of the results of research to be the ultimate ambition of pure science? This is the text upon which Clemens Herschel, president of the American Society of Civil Engineers, based an address delivered last week before the annual meeting of the American Association for the Advancement of Science. Speaking with the utmost frankness, he told the scientists, in effect, to be useful, not merely erudite; to serve mankind rather than pin butterflies on cards. Not less interesting than Mr. Herschel's message itself was the manner in which it was received by the audience. Of several speeches by officers of national engineering societies his was the only one which evoked more than perfunctory applause. If this is indicative of anything, it is that pure science, whatever may have been its attitude in the past, is awakening to a new

sense of responsibility and of opportunity. Certain it is that the European war has been the means of throwing light upon the possibilities of a closer co-operation between pure science and engineering—a co-operation which concerns itself not so much with the production of the implements and materials of warfare as with those of industry back of the firing line.

The Profession of Engineering

THERE has been much comment on the very rapid development in the broader relations which have developed among engineers in the last two or three years. It is apparent that some power is at work whose effect is to counteract the tendency to split off into new specialties. But though there has been much comment, there has been little attempt to discover the philosophical basis of the movement. Gano Dunn, in his article on "Professional Unity Among Engineers," page 4, presents what appears to be the basis for the remarkable synthesis now in progress. That basis is the unity in the thinking of all engineers—the scientific habit of thought. Put in another way, engineers are fundamentally scientists. They approach problems from the same angle. Their methods of investigation are essentially one. Consequently, when general problems are discussed the one engineer follows the other's reasoning with ease. There is quick response, ready sympathy. Fundamentally, it is this spirit that is bringing us together.

Retrospect

FROM the standpoint of the engineer and the contractor the year 1916 cannot be said to have been remarkable. Save for building work in industrial sections, the volume of construction was not in proportion to the country's development. From coast to coast the high prices of materials and labor have retarded the progress of work. Consequently, contracting organizations have gone along on a reduced scale. The employees have not suffered, because they readily found work in other lines. Whether many of them are lost permanently to construction work remains to be seen. Undoubtedly, with the slackening of activity which will mark the change from a war-business basis to normal operation many of these will find their positions less attractive than they are at the present minute, and will again seek employment in the field to which they are accustomed. Inevitably, however, the organizations must suffer because of their disruption. There is one bright thought, however, in contemplating the reduced construction record of the year now passed, namely, that the work held in abeyance must eventually be done, and that some time, as a result of the postponement, there will be an extraordinary volume of construction work, much to the advantage of both engineers and contractors. Whether the quickened activity will come this year is doubtful. Should peace be declared soon the revival might start this year, but all factors being considered—the temper in Europe and

the probable length of the period of adjustment—it is likely that the volume of construction work in the civil engineering line this year will not be above normal.

The Prospect

A WAR YEAR must always be one of uncertainty, particularly when the conflict has reached the magnitude of that in progress in Europe. Consequently, the year 1916, despite its unprecedented business, was not of the kind to make us feel contented. Shall we be dragged into the maelstrom? What will happen at the war's end? Such were the questions that ruffled our business composure, that made us doubt and fear, even though the immediate business was phenomenally good.

At the present moment, though, there seems to be more confidence in the future than there was last January. There is still ample reason for speculation on the possibility of our being drawn into the war. There is also room for doubt as to what will happen after the war is over. Yet on the latter question, there is less fear than there was a year ago. Then observers freely predicted a severe depression as the accompaniment of the return of peace. Now, while there is some reservation, there is a well-defined confidence that our prosperity will continue for a year or more after hostilities cease. The prosperity may not be on the same plane that it is now, but it is believed that mills will continue running and all of our people be employed.

This feeling of confidence is based on both the foreign and domestic situations. In this country much needed work has been held in abeyance because of the high labor and material prices. When the war is over, capital will still be plentiful here, while the almost inevitably lower prices for men and materials will allow work to be executed on more favorable conditions than obtain to-day. Consequently, the quickened domestic demand will go a long way toward supplying to our mills the business that will be lost when war orders cease to come. What obtains here—the holding of necessary work in abeyance—obtains generally throughout the world, in both neutral and belligerent countries. In countries untouched by the war there will be more than the normal quantity of peace business, while in those unfortunate sections which have been overrun by the armies reconstruction must start on an entirely unprecedented scale. No matter how excellent the post-bellum industrial organizations now being planned in the various European countries, it is inconceivable that they will be able to take care of rehabilitation in the battle areas and the supply on a supernormal scale of oversea demand. Likely we shall have to change our basis considerably—our cost of production must be considerably lowered. This undoubtedly will come, and come quickly, and then we should have a large share in supplying the materials for rebuilding Europe and helping other countries catch up their retarded development.

It must be said, of course, that many factors will operate. What, therefore, will be the final result after

the close of the war no one can positively predict. The best observers, however, are sharing in this feeling of confidence, expecting that the readjustment will be brought about quickly and without serious disturbance of our conditions. When Europe and the foreign countries have been served, after a year or two, then, these observers believe, will we face the real crisis.

The year 1917, therefore, starts out with a more hopeful tone than did 1916. It will have its full share of troubles, without doubt, but the dangers and difficulties are better appreciated and discounted than they were a year ago.

Valuation—Its Present Status— Prospects for the Future

LAST WEEK the long-awaited report of the special valuation committee of the American Society of Civil Engineers appeared in the *Proceedings* of the society. Until then the federal valuation of the carriers dominated the valuation picture even more completely than a year ago. The outstanding events of the year were the reporting by the Interstate Commerce Commission during October and November of tentative valuations of several railroads, and the filing of formal protests by two of these roads. While no really large railroad has thus far been included, the reports are significant in showing the general attitude of the commission, and in presenting test cases on which the Presidents' Conference Committee may be expected to concentrate its attention.

The American Society report proper contains 211 pages. It is preceded by an abstract, but although this contains 12 pages the committee hopes it will not be used by the members of the society as the sole basis for their conclusions and discussions. Snap judgment on so weighty a document would hardly be in order, and the *Engineering Record* will reserve detail comment until next week. The report looks, however, to have been worth waiting for. Out of the known divergences of views between the old and the new members of the committee have come an adjustment and an analysis that is apparently a credit to the society.

The principal bone of contention—the depreciation question—is met by the conclusion that whether or not depreciation should be deducted in rate cases depends on the character of regulation of the utility. Railroad renewals, except recently in the case of equipment, have always been and still are made as required and charged to operating expenses, without consideration of any accumulating renewal fund. The committee calls this the replacement method, and holds that under it no deduction for depreciation shall be made, unless there is deferred maintenance. Where the regulation recognizes the need for a growing fund, however, the committee thinks depreciation should be deducted, but credit should be allowed for whatever fund is found. In other words, the utility must not dissipate the funds in dividends, but may reinvest them as it sees fit. The old

equal-annual-payment method is rechristened the compound-interest method, and is recommended where a fund is to be created.

Considerable space is given to the clarifying or modification of ideas previously set forth by the committee, but space limitations prohibit their discussion here.

Turning now from the academic discussion of valuation in general to the vital questions of the government's great undertaking, the first tentative valuations of the Interstate Commerce Commission are not encouraging. In the main the commission seems to have disregarded the arguments presented by the carriers and adopted the state-commission plan of keeping the figures down by main strength. True, the commission, finding it impossible, as was predicted, to trace actual original cost, and evidently unwilling to estimate it, has disappointed the state commissioners by declining to pitch out of the window the only obtainable figure—reproduction cost. True, also, the commission has rejected such fantastic theories as instantaneous reproduction, and public ownership of railroad land, and has revolted against presenting as reproduction cost of land what it knows is nothing of the kind. But it has still evaded the issue by reporting "present value" of land and giving no inkling of what it regards as true reproduction cost. Contingencies, working capital and development expenses have all been disregarded, and engineering and other overhead have been scaled down below what experience shows these things cost. Likewise, according to the railroads, in dealing with actual construction quantities, classifications, unit prices, construction periods and interest rates have been pared down. Properly, this journal believes, the commission, despite the protests of the carriers, has recorded accrued depreciation, which must have a bearing on sale value, but improperly and inconsistently it has disregarded such other values as advantageous location, which are reflected in net earnings and are certainly a part of sale value. Appreciation is likewise ignored.

Hence the significance of the public hearings soon to take place. The differences may be amicably adjusted, but the prospects are not bright. The Interstate Commerce Commission appears to have accepted the state-commission view that the paramount object and supreme necessity of the valuation is to keep the figures down. Unless it modifies its attitude extensive litigation can be expected when attempts are made to put the valuations to use.

Because of this state of affairs, the new report of the American Society's committee has appeared on the scene none too soon, and it is to be hoped that no flaws will be found in it to force it back on the committee. Perhaps the time has already gone by when the engineering profession can take a hand in the molding of valuation principles and policies; but if the society, as now looks probable, can put forth in the near future a fundamentally sound statement of principles perhaps much of the false theory that now seems so potent can be pushed aside.

Professional Unity Among Engineers

Splitting of Engineering Into Specialties Has Been Followed by Remarkable Synthesis, with the Scientific Method of Thought as the Common Bond

By GANO DUNN

Chairman, Engineering Foundation; President, J. G. White Engineering Corporation, New York

THE turn of the year would not be adequately chronicled if notice were not taken of the remarkable incidents, culminating in 1916, that can have nothing else for their explanation than the increasingly rapid growth of a consciousness among all who call themselves engineers that they are not isolated specialists but units in a profession of increasing importance and dignity.

It was easy a generation or two ago to discuss engineers as a class, for the class was small and relatively undifferentiated.

DEVELOPMENT OF ENGINEERING SOCIETIES

Making its appearance about the middle of the seven-teen-hundreds, this class until hardly more than fifty years ago was regarded as composed of artisans or specially skilled laborers with whom, as a group, the world had little to do. Since that time, through the application of the scientific method of thinking, derived from the pure scientists and applied by the engineers, the features of the industrial world have been completely changed and the activities and welfare of communities, governments and peoples so greatly altered that the class, enormously increased in numbers, which has brought about these changes can with justice be said to have established a new and, in the eyes of the world, a fourth profession.

The civil engineers were the first to organize and all branches of engineering were included in their category. In this country differentiation began by the branching off into a separate organization of the mining engineers, who were followed in turn by the mechanical and the electrical engineers. The chemists founded their great organization directly prior to the organization of the mechanical engineers.

THIRTY ENGINEERING BRANCHES

At each of the above stages, subdivision was accompanied by large increase in numbers, and while the five groups referred to now constitute the principal national engineering societies, in one or more of which a preponderating number of the important engineers of the country hold memberships, the differentiation and subdivision have been continuing at an accelerating pace, until there are now recognized about thirty separate engineering branches, most of which have their own organizations. Radio, illuminating, refrigerating, heating and ventilating, industrial, agricultural, aeronautical, sanitary, metallurgical, municipal and other engineers, in a list too long to enumerate, constantly come to our attention.

When the tendency to differentiate and split off first appeared it was resisted by the great national societies in turn, in the fear that the new branches were but schisms and bode ill to the power and effectiveness of the respective parent. Contrary to expectations, the

parent societies have increased in membership instead of decreasing.

It is not easy at this juncture to see, in respect to *technical activities*, what the fundamental tendency in all this amplification is. But in respect to *professional activities* he would indeed be without eyes who cannot read the signs of the times among engineers as a class.

THE SYNTHESIS

If it has been disconcerting to a telephone engineer possessed of pride in his profession to find himself increasingly specialized away from the electrical railroad expert or if a hydraulic engineer feels lost in the subject matter of the fluid frictions of the aeronautical engineer—if indeed the term “engineer” has come no longer to give an inkling of what a man actually does, let us not despair, for the very manifold diversity of occupation comprised under the term “engineering” of itself throws all engineers back upon and brings into brilliant prominence a quality they have in common.

That quality is their *method of thought*. It is this which is responsible for the remarkable events of the last few years, and conspicuously of the last year, and which is proving that engineers are indeed one instrument—a great profession.

From the radio expert to the metallurgist they all have followed in the steps of Galileo and have learned the scientific method, and it is this method and not the subject matter of their occupation that is building up the great engineering profession. The consciousness of training and experience in this method is the centripetal force evolving professional unity.

Perhaps I ought to add as an element of the professional bond the quality of action that derives delight in applying the scientific method to practical and useful purposes.

With a more or less unconscious sense of the bond goes a clearer feeling of dependence upon pure as distinguished from applied science and a recognition by engineers that at their best they are working with tools put into their hands by men devoted to pure science, that is, to research for its own sake.

THE SIGNIFICANT EVENTS

Amidst the apparent decentralization and dissipation of common technical interest accompanying extensive specialization and separate organization of branch after branch in the technical specialties of its own new field, what are the proofs of the synthesizing tendency to which this article is devoted?

In 1903 three of the great national engineering societies decided to live together in one home and founded the United Engineering Society, a corporation whose functions are wholly professional to the exclusion of the technical.

In 1903 in order to do honor to a great mechanical

engineer four of the great societies established the joint administration of the John Fritz Medal Board of Award for the bestowal from time to time, in perpetuity, of the John Fritz Medal, the award of which was not limited to mechanical engineers, but thrown open to engineers of all branches.

In 1911 there was established by the American Institute of Electrical Engineers the beginnings of the joint conference committee of the four national societies in order to bring about co-operation between the electrical engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers and the American Society of Mechanical Engineers.

In 1915, through the munificence of Ambrose Swasey, The Engineering Foundation, created by the United Engineering Society, was established for the promotion of scientific and engineering research and the good of mankind, which foundation is administered by a board of representatives of the great societies.

In 1915 the oldest and most distinguished of the engineering societies, the American Society of Civil Engineers, decided to give up its handsome separate home and come into the fraternity of its associate national societies.

PUBLIC ACTIVITIES

In 1915, also, the President of the United States recognized the importance of engineers in national defense and called upon the national engineering societies and chemists to designate representatives that should constitute the Naval Consulting Board and its subsidiary Committee on Industrial Preparedness. The establishment of this board and its adjunct marked an epoch in the relation of engineers to the nation, and the association with the engineers of the great national society of chemists also marked an epoch in the internal progress toward professional unity.

In 1916 was started the movement to form a Civic Scientific Alliance out of the material of the national engineering societies. The year 1916 also saw the beginning of what constitutes perhaps the climax up to date of the professional, as distinguished from the technical, activities of engineers—co-operation with the scientists in the formation of the National Research Council. The president of the National Academy of Sciences, the only

scientific organization in the nation created by charter of Congress with the duty of serving the Government of the United States, was requested by President Wilson to create a council that should organize and co-ordinate all the governmental, educational, institutional, industrial and private agencies for scientific research, in order to further the national defense and the development of the resources of the country in time of peace.

The Engineering Foundation, standing in respect to this proposed council as the representative of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers and interpreting the growing sense of dependence upon pure science increasingly prevalent among engineers, proffered its whole resources to supply the funds and personal assistance needed by the National Research Council in its initial stages. Out of a corresponding appreciation of the importance of engineering in bringing about the application of the principles of science to the national and industrial problems of the country the proffer was accepted by the National Research Council and an important representation from the engineering profession was invited to sit among its members.

THE FUTURE

One cannot peruse the above chronology without the conviction that from many separated quarters the tendency of engineers to unite and exercise their influence, by virtue of the spiritual wealth they in common possess, is strongly manifest; nor can one escape the conclusion that this wealth binding them together is the sympathy springing from common possession of the scientific method of thinking and a love of action.

Viewing the tendency and witnessing its strength, it is evident that as a profession we are becoming consolidated and are on the threshold of greater accomplishments in our relations to society in general. With a strong sense of responsibility toward the nation and with rapidly developing machinery within our organizations for dealing with professional and public questions, we are not only fostering our scientific and engineering interests, but are creating a place for the engineer in national life.

Engineer's Relation to Foreign Expansion

Development Work Essentially of an Engineering Character—International Point of View and Broad Training Necessary for Success

By CHARLES A. STONE

President, American International Corporation

INTERNATIONAL dependence has acquired a new meaning to Americans since the outbreak of the European War. Those engaged in foreign trade or in industries closely affected by importations from Europe have realized that there was no such thing as international independence. They saw that nation was knit closely to nation by commercial bonds and that a ruthless and widespread severing of those bonds would turn the whole world topsy-turvy. But while some

realized this international dependence, it required the shock of a world war to bring even the thinking class in the United States to a realization of international economic relations. So severe was the shock that even those who are not given to thinking about the broader problems that affect us as a people are aware that something has gone amiss, that the customary balance has been destroyed.

Viewed broadly, one effect of this great shock has

been to start us thinking internationally instead of nationally. I do not say we have, as a people, made much progress in this (to us) new habit of thought. It is but a start. Yet it is encouraging. If we are to bear our part well as a member of the great family of nations we must readjust our views of foreign affairs, of foreign trade—of all our foreign relations, whether diplomatic or commercial. We must recognize that we are not to be an isolated nation, whose sole policy is to look to our selfish interest, to the neglect, as occasion dictates, of the rights of some nations and of our responsibilities to others.

INTERNATIONAL POINT OF VIEW NEEDED

Since our foreign commercial and investment relations are much affected by legislation, and since this is ultimately a reflex of the nation's thinking, it is important that an international point of view be acquired by our people as a whole. Naturally our thinking classes must lead in this change in national viewpoint. Particularly is it necessary that those whose professions or avocations have a direct bearing on foreign trade and foreign investment development acquire quickly the broader outlook. Engineers are, needless to say, a necessary factor in this development. It is important therefore that, as a profession, we grasp the significance of America's present position in relation to world affairs.

It is unnecessary to present in detail the conditions that have brought foreign investment and foreign trade to the front. Unfortunately the point of view commonly taken is that we should take advantage of the embarrassment of European nations to win from them, so far as we can, their foreign customers and their foreign investment fields. The point of view to be encouraged is rather that America, having become able, no matter what the cause, to finance foreign work she should do her share toward world development. It may be said that the difference here emphasized is a mere quibble, that in any event the result is the same—a taking advantage of the situation which restricts the activities of Europeans. But the mental attitude may make a tremendous difference in the way we shall handle our world-trade relations after the war, and a tremendous difference, too, in the stand that foreign exporting countries will take toward us. The one attitude would encourage ruthless trade war; the other, by providing the funds which are now much needed, will lead to co-operation and may avert retaliatory measures. Our expansion into the foreign field, then, does not mean that we must take trade from European exporting nations. It means rather that the development of backward countries will be the more rapid and that in addition to English, French, German and Dutch capital, American money will be available for investment in foreign enterprises. There will be more business for all; the rate of progress in backward lands will be accelerated.

EXPANSION INEVITABLE

Moreover, while the war has tended to hasten our entrance on a broad scale into the foreign field, it was inevitable that we should eventually take our part in world-development work. Less and less have we had need for foreign financial help in our domestic enter-

prises. At the same time our exports have been growing. Before long there would have been surplus capital here that would have sought employment abroad. The war has merely hastened the day.

If we turn to the foreign-trade histories of England and Germany we will find a counterpart of our own progress toward wide trade relations. England has been the great developer of nations. She became so through her attainment early in the last century of a strong financial position and of pre-eminence in manufacturing. As Germany's wealth increased and as she became largely a manufacturing nation she, too, sought employment abroad for her capital and a market for her surplus products. Now, in turn, these two factors—great wealth and a large volume of manufactures—are putting the urge upon America.

THE ENGINEER'S RÔLE

A closer view of England's foreign-investment progress and foreign-trade expansion of the last century will indicate the agencies we must employ and will show how vital is the position of the engineer in our future expansion. England's pioneers in all cases were the engineers and their co-workers, the contractors. The professional promoter is an American product. The development of a country is essentially an engineering task—the building of railroads, of ports, of municipal works, of public utilities. England's mechanical and engineering superiority in the early part of the last century, combined with her wealth, fitted her admirably for such development work. Great firms sprang up that carried British engineering genius to every part of the world—and where England's engineers went and invested English gold, English trade followed. Thomas Brassey, the well-known contractor, whose life written by Sir Arthur Helps reads like a romance, was one of the greatest of these English engineering pioneers. Having demonstrated his capacity in the building of the London to Southampton railway, he subsequently built the line from Rouen to Paris, and within some fifteen years of his London and Southampton work was employing 75,000 men on work involving a capital outlay of \$180,000,000. The work was scattered through France and the United Kingdom. Then came his marvelous expansion into foreign fields—Holland, Prussia, Spain, Italy, Canada, India, Australia and South America.

Others followed in his footsteps, and to-day such great firms as S. Pearson & Son, Ltd., Sir John Jackson, Ltd., Pauling & Company, Ltd., and C. H. Walker & Company, Ltd., engineers and contractors both, continue to serve as the pioneers for English trade expansion, for trade follows investment, and these firms build English investment money into public works, utility systems and industries.

LESSONS FROM EUROPE

Powerful German engineering and construction companies, such as Philip Holzmann Aktiengesellschaft, have developed, too, and their work forms the basis for greater German trade.

We now have the material basis, surplus funds, for foreign expansion. But if we are to follow in England's and in Germany's footsteps we must have, as they have had, a large number of able engineers,

broadly educated, as soundly grounded in economics as they are in engineering and who have the will to engage in work in foreign lands. Moreover, as has been already emphasized, they must be trained to think internationally. With engineering ability to solve problems here at home we are abundantly supplied. The foreign field, however, manifestly demands greater abilities, broader training and wider vision. If we are to bear our part well in the future world development our schools must appreciate the need and prepare the men for the task. Happily some of our great engineering

schools, among them the Massachusetts Institute of Technology, Cornell, Sheffield and Rensselaer, are awake to the opportunities, and in a very few years we shall have our graduate engineers trained to think and to speak internationally and find many of them seeking the opportunities which await them in foreign lands.

America will profit not only through the direct returns and through the stability which will result from a large foreign trade, but through the contact with world conditions that will bring new viewpoints and experiences to help solve our national problems.

Making a Success of Road Contracting

Summary of the Factors That Need Attention in Getting the Contract and in Executing the Work—Imagination a Necessary Quality

By H. ELTINGE BREED

First Deputy Highway Commissioner, New York State

ALL contract work is hazardous. That the building of roads has perhaps more often than any other form of construction proved itself a losing venture for the contractor is due to many causes. Within the limits of this article we can suggest only a few, general ones, which apply with equal force to every piece of highway work and for which there are definite remedies. They will be discussed under two general heads, "Getting the Contract" and "Doing the Work."

First it may be noted that many contractors who are successes in other classes of work fail when they attempt highway work. Why? Because they lack imagination. They fail to discriminate between the static piece of work, such as a skyscraper, a bridge or a dam, where they can keep the whole procedure constantly under their eye, and the prolonged stretch of work on the highway, where their personal supervision at any one time can cover only a small fraction of the work. The highway is 10 miles in length. The contractor at no point can see more than 90 yd. His imagination must carry him over the 17,510 yd., meeting every condition his workmen are meeting, dovetailing every detail to a nicety, inspiring his force with esprit de corps—an intangible asset worth many dollars on any job. If the contractor lacks this power of imagination, if he cannot project his personality through space into the minds and hands of every workman, then he had better stay out of highway work.

Getting the Contract

But supposing he can honestly tell himself that he has these personal qualities, then his immediate practical concern is to get the award of the contract. He must prepare his bid. In doing this the essential thing is to make a thorough examination of the project in hand, personally, if his experience warrants it, or through the employment either of an experienced contractor or of an engineer who has had contractual experience. The contractor who tries to avoid the expense of such services often disregards important factors or cheerfully accepts them as hazards which may come out all right, but which, going entirely against him as they often do, may cause his financial downfall.

These are important items to be considered in looking over work: (1) Plant, (2) local data, (3) climate, (4) financial arrangements, (5) cost data. They will be discussed in order.

1. PLANT

Has the contractor plant suitable for this particular job? Does he wish to buy such plant as a permanent investment? Will it pay to buy special equipment for this one piece of work?

While the difficulty and cost of getting labor constantly increase and its efficiency as constantly decreases, plant may often be made to pay for itself. Special equipment, even, may so reduce the price per mile as to lower the bid even after the first cost is included. But the contractor rarely wants increased plant to represent all his profit on a job.

Further considerations about plant should include: (a) the relative economy of portable and semi-portable plants, (b) ease of manipulation of various units of plants, (c) transportation facilities for placing and moving plant.

To form an intelligent estimate of the price to be charged against the items for plant, one must figure the approximate cost of the plant, plus its depreciation and repairs, plus the cost of its operation and supplies, plus the cost of transportation to and from the work, and the setting up, less the salvage value when the work is complete. One must estimate its average daily capacity. With steam-shovel work, one must plan for enough equipment to keep the shovel continuously busy.

2. LOCAL DATA

Under this head, accurate computations can be made only by one thoroughly familiar with local conditions.

He must know the local labor market. Will his men work eight, nine or ten hours a day? At \$1.75 or \$2 or \$2.25? Compensation and insurance must be figured.

He must know the situation in respect to materials—their accessibility, cost, available quantities, methods of transportation and length of haul.

He must know what provisions will have to be made for maintaining traffic.

He must decide whether pipe line will have to be installed to secure an adequate water supply.

He must determine the character and formation of the rock, and the depth of cutting.

He must understand the soil conditions and drainage, and be able to estimate the amount of wet excavation in ditches and foundations.

He must gage the necessary shifts of plant.

3. CLIMATE

On climate and the number of working months depends the length of contract a man ought to take for one season. If the climate is bad, the work will be delayed. Under fair climatic conditions, such as obtain in most of New York State, a man could safely undertake from 3 to 6 miles with one plant and from 6 to 12 miles with two plants.

4. FINANCIAL ARRANGEMENTS

Organization costs money. Overhead charges and superintendents' salaries must be counted in the cost of work. The contractor *must* have sufficient capital at his command to meet these charges, to pay for whatever new plant he needs, to cover transportation and freight charges, to meet his first payrolls, and to do the early part of the work, which is often the most expensive and unprofitable part. The interest on this capital, whether borrowed or not, should be added to the bid.

5. COST DATA

"Handle with care!" Cost data represent averages. Conditions peculiar to a particular piece of work may vary those averages 100 per cent. On the wrong side, they may spell failure.

After these points have been carefully weighed, a few other suggestions may protect the contractor from an injudicious bid.

1. Bid a price sufficient to pay for new plant necessary, less its salvage value, and charge off depreciation of plants against your profits.
2. Protect yourself on the prices of all materials.
3. Figure everything accurately. Don't guess.
4. Remember that contingencies arise.
5. Bid higher if the market in labor and materials is rising; lower if falling.
6. Study your specifications.
7. Remember that the unit price depends on the size of the job.
8. Avoid "office bids," as the easy path to failure.
9. Estimate your profits.
10. Make *your own* bid; other contractors may make unbalanced bids or have special facilities for doing the work cheaply.
11. And don't try to beat the other fellow just because he once beat you.

Doing the Work

When the contractor has submitted his bid, and has been awarded the contract, he should begin work at once, taking up the key piece of the jigsaw puzzle, about which every other piece must be ready to fit instantly with absolute precision.

The key piece is his financial arrangements. Weakness here is the cause of many failures. If a man's credit is poor, he must pay a higher price for all materials. If

he is behind on his payrolls, he gets less work out of his men. If he has to assign his estimates, he becomes an object of suspicion to all who do business with him. For success and for his own happiness he *must* have adequate financial support. This must cover overhead expenses and payrolls until the work is in full swing; bond, insurance and compensation; installation of plant, and new plant to be acquired; materials and freight charges. He must remember that until a large percentage of the work has been done, and the payments for it begin to come in, he will have to keep on investing more capital every month. In requesting loans, therefore, a man should estimate liberally, and then keep within them. That inspires a bank with confidence, and means good credit.

HOW TO ORGANIZE

A competent superintendent should be employed, one who has the ability to do everything without recourse to an overhead organization. He should be given authority and power to act in full whenever it is necessary. He must possess character, business ability and the qualities of leadership.

The most successful contractors organize their work on the basis of time, allowing a definite number of months for the completion of the work. By arranging a schedule, the contractor with imagination will plan exactly how and when each item can be done, what materials it will require, the time of their delivery, and the perfect adjustment of all the different classes of work, so that the job may move forward as an entity and not as a process of loose ends.

It is poor policy to try to do all the profitable items of work first, such as placing the pavement before the drainage has been perfected. Large losses may result from such procedures, especially if the weather turn bad.

PLANT, LABOR, METHODS

Necessary plant should be procured at the lowest possible expense. It should give the lowest unit cost when figured on a basis of time. By decreasing labor costs and labor troubles it may turn the scale against a losing job. It should always be supported on adequate foundations, which are cheaper than the smash-ups and delays caused by the lack of them. Extra parts should always be on hand in case of accident. Money will be saved by careful planning for the smallest number of set-ups.

There is no better asset on a job than a force of well-cared-for, contented workmen. The contractor will get much better results if he engages the men himself, instead of obtaining them through the contract system. To do this may require a larger outlay in money and energy, at first, but it will give returns beyond measure. They will further increase if the men are provided with good quarters and an economical commissary. The men, as well as the machines, need care and fuel if they are to be 100 per cent efficient. They need something more—good discipline, and a good working spirit diffused among them by the superintendent and contractor. The grumblers should be ousted and the good workers advanced as far as possible.

The successful contractor is always on the alert to improve his methods. Because a job is going well, it does not mean that it might not go better. Profits

may always be increased by attention to details of procedure. When the daily cost of one method of work has been ascertained it is often wise to test another method and compare results. The work should always be planned so that, once started, the men can work uninterruptedly at one thing for a full day.

POINTS THAT CONTRIBUTE TO SUCCESS

Here are some points that contribute to a contractor's success in highway work:

1. Always make excavations for cuts uphill; this drains your work.
2. Upon good drainage depends your ability to keep your men working.
3. All your contracts for materials should be executed for the life of the work.
4. Keep all your work going together, and keep your full-time men busy on rainy days; you can find something for them to do.
5. Keep your roller going all the time. You pay your roller man; make him work.
6. Have your materials ready in advance; then you will not be delayed when you are ready to use them.
7. For concrete work, buy the type of mixer that will do for both base and pavement work.
8. Keep each man at his own job in his own place. To let the men get in one another's way wastes time and money.
9. Keep your cars unloaded; don't pay demurrage.

10. Provide enough labor and teams to keep your plant working at full capacity.

11. Good storage facilities save your materials and your money.

12. Remember that it costs from \$200 to \$500 a mile to winter finished work.

13. Remember that every day over your time limit increases overhead charges and decreases your profits.

14. Successful work proceeds throughout the day in well-ordered continuity.

TO SUM UP

Briefly, the success of large and small contractors in road work depends upon their ability to conduct a flexible, shifting organization; to plan and execute a mass of details, each trivial in itself, but contributing importantly to the whole; to "plant" work economically; to realize that intensive methods will not apply to extensive work; to obtain a good working force and especially a good superintendent; to finance the work adequately, and find profit in dollars rather than plant.

The suggestions above are generalities. Upon the human factor depends their successful application. Not every man can be a contractor; not every contractor can be a success in highway work. But the man who can, the man who possesses the personal qualifications and the understanding of working principles, will be a valuable factor in the nationally beneficial work of extending the mileage of good roads.

Material Prices Reflect Labor Conditions

Except for Steel, Where Heavy Demand Has Accounted for Portion of Advance, Increases in Prices of Construction Materials in General Appear Due to More Permanent Causes

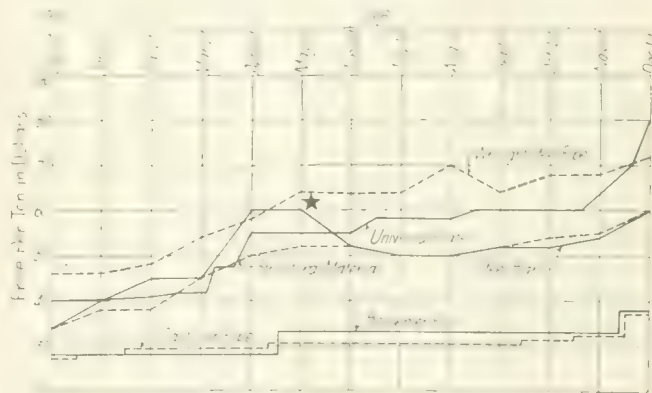
By HENRY D. HAMMOND

Associate Editor, Engineering Record

PRICE INCREASES are usually due to one of two kinds of causes. The first are those resulting in an increase of demand beyond visible supply and the second in increase in the cost of production. Causes of the first kind may be, and usually are, of a temporary nature. Causes of the second kind are generally due to permanent changes and readjustments of the entire economic structure. When temporary abnormal demand eases off, prices advanced by this demand will drop. On the other hand, when labor, standards of living, costs of most raw materials and production costs in general have increased, forcing a rise in the price of commodities, even those economic upheavals known as panics are powerless again to level prices except for the moment. Price advances from the second set of causes are therefore likely to prove permanent.

Of the price advances during 1916 in construction materials, illustrated in the charts and diagrams, only those of steel products are due to a combination of causes of both kinds. Other materials have changed less consistently and through a smaller range, and the causes for gains, where these are shown, may be traced in nearly every case to the second group. Advances in steel prices, therefore, so far as they are chargeable to abnormal demand, may not be maintained when this

demand falls off. On the other hand, that portion of the advances in steel prices due to increasing production costs and most of the advances of other construction materials must be considered as more permanent. Prices for such materials may again fluctuate below the levels of 1915, but the history of economic progress shows that they can never be expected to settle perma-



RAIL AND CAST PIPE STICK CLOSE TO PRODUCTION COST, WHILE OTHER ITEMS SOAR ON EXCESSIVE DEMAND

The star indicates the point where mills began to distinguish between open-hearth and Bessemer steel, lower prices being quoted on the latter steel to move it more freely.

demand. Reliable statistics, including the operations of every fabricator of consequence in this country, show that the amount of construction into which fabricated steel has entered has been less during the past year than in 1915. Statistics for general building construction show a gain, it is true. Yet, although concrete and wood have replaced the high-priced steel in many projects, and though industrial building has more than proportionately doubled, statistics indicate that the total volume of building for 1916 will fall well below that for 1909 and may not much exceed that for 1912.

For general construction work, no reliable figures are available. Undoubtedly, however, such work has, except for highway construction, been far from active. For every important letting there is a flock of hungry bidders. No general contractor, aside from those in the building and road fields, will point to 1916 as a normal season. Where, then, is to be found evidence of increased demand to account for the slight price advances noted in most lines? The answer is that these rises

must in general be accounted for on some other theory.

One cannot escape the impression that the increased cost of labor and raw materials has compelled the manufacturers of most construction supplies to raise prices in a market not naturally favorable to such advances. Prices have gone up, where they have been able to rise at all, because general business is on a higher level, and the producers of construction materials, caught between the devil and the deep blue sea, had to put them up or retire from business. Naturally, these increases have resulted, in connection with the cost of steel, in curtailing still further the volume of construction. It must be remembered, however, that these increases are only an intermediate factor in the curtailment, so widely complained of. The underlying causes are to be looked for in the general labor shortage and the general increase in production costs, combined with the fact that peculiar circumstances have continued to keep the railroads, a most important group when it comes to keeping the general contractor busy, out of the market.

Contractors Meet Labor Shortage with More Plant and Better Organization

Replies from Large Firms Whose Operations Cover Country Indicate Growing Seriousness to the Construction Business of Labor Scarcity

By HENRY D. HAMMOND

Associate Editor, Engineering Record

A SCARCITY of labor over most of the country is being met by efforts to secure increased efficiency by the use of more labor-saving tools and more careful planning and organization. Such is the gist of replies reaching the Engineering Record from large contractors in every part of the United States in response to a request for information on the labor situation. It is evident from these replies that throughout the entire country, except in the thinly-populated Southwest, common and skilled labor for new projects is increasingly difficult to secure and increasingly restless and hard to keep. Labor conditions are forcing a consideration of the human element and a use of construction plant and of improved methods of planning and organizing work such as this country has not seen before. While it is true that promoters seldom consider directly the market for construction labor in starting new projects, it is yet evident from these replies that the general labor shortage, resulting in higher construction and material costs, in slower deliveries and often in slower construction progress, has been a major factor in curtailing the volume of construction work, and is likely to have a still greater effect next year.

SHORTAGE NOW COVERS MOST OF COUNTRY

The actual changes in the labor situation since 1915, and especially since the end of last May, when a similar census was taken on this subject, from which one of the accompanying maps (reprinted from the Engineering Record of May 20 last) was made, are highly significant. It will be seen that wages in the north-eastern quarter of the country, containing more than

60 per cent of the population, have not risen since last spring. This can only mean that the limit has been reached in this territory beyond which costs cannot advance without shutting off work. Indeed, for some groups of clients, this limit has been passed and their work is actually being postponed at the present time. In general, clients of contractors cannot compete with the wages offered by manufacturing and munitions plants for common and skilled labor. So serious is this condition that the head of one of the largest construction firms in the East stated that he has avoided taking new contracts for six months, and will continue to do so until a change occurs.

WAGE ADVANCES EXTEND OVER WEST

It will be noted that the area of wage advances has extended over the whole northern portion of the country during the past six months. F. W. Weymouth, chief of construction of the United States Reclamation Service, reports that a labor shortage is now noticeable on all projects of the service west of the one hundredth meridian (running through Iowa and the Dakotas), excepting those in the extreme south, where Mexican labor is available. On the North Pacific Coast unprecedented shipbuilding activity has cut seriously into the supply of construction labor, wages have advanced materially and unrest is prevalent.

MUCH NEGRO LABOR HAS LEFT SOUTH

Even in the South, the labor supply is fast being depleted. Negroes are reported to have come north by the thousands. Officers of James Stewart & Com-

pany, Inc., report difficulty in securing sufficient labor as far south as Norfolk on the Atlantic Coast and Oklahoma in the West. Prosperity has just struck the South, which depends largely on agriculture. From last year's cotton crop, sold at record prices, will be realized the money to finance operations on a scale which was possible for other sections last year. It will not be a surprise, therefore, to find wages advancing and conditions growing more serious in this section during 1917.

Only in Texas and the extreme Southwest have labor conditions remained unchanged. However, affairs in these border states hinge to some extent on the final outcome of the Mexican tangle, and it is possible that when these troubles are adjusted commercial development will set in on a scale requiring considerable construction. It must not be forgotten that even these states have lost labor to other sections.

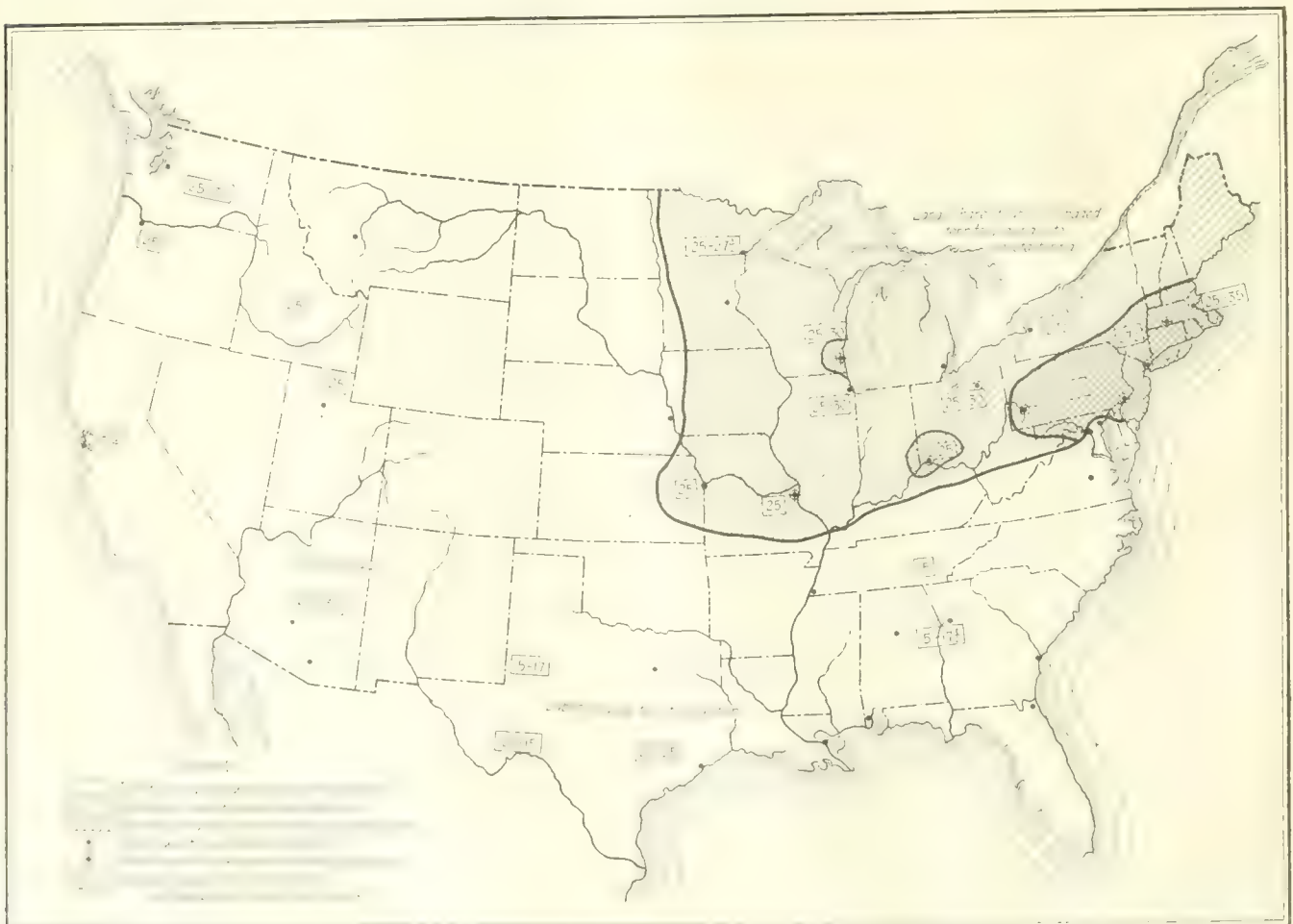
LABOR LESS EFFICIENT

The effect of the situation on the efficiency of construction labor is pithily summed up by A. B. Greensfelder of the Fruin-Conlon Construction Company, of St. Louis, in the statement, "Available common labor is less skilled than formerly and skilled labor is less common." Almost without exception the large operators have found the same trouble. Because of a short and inferior supply of labor, men like J. W. Rollins of the Holbrook, Cabot & Rollins Corporation, H. C. Turner of the Turner Construction Company, W. P. Anderson

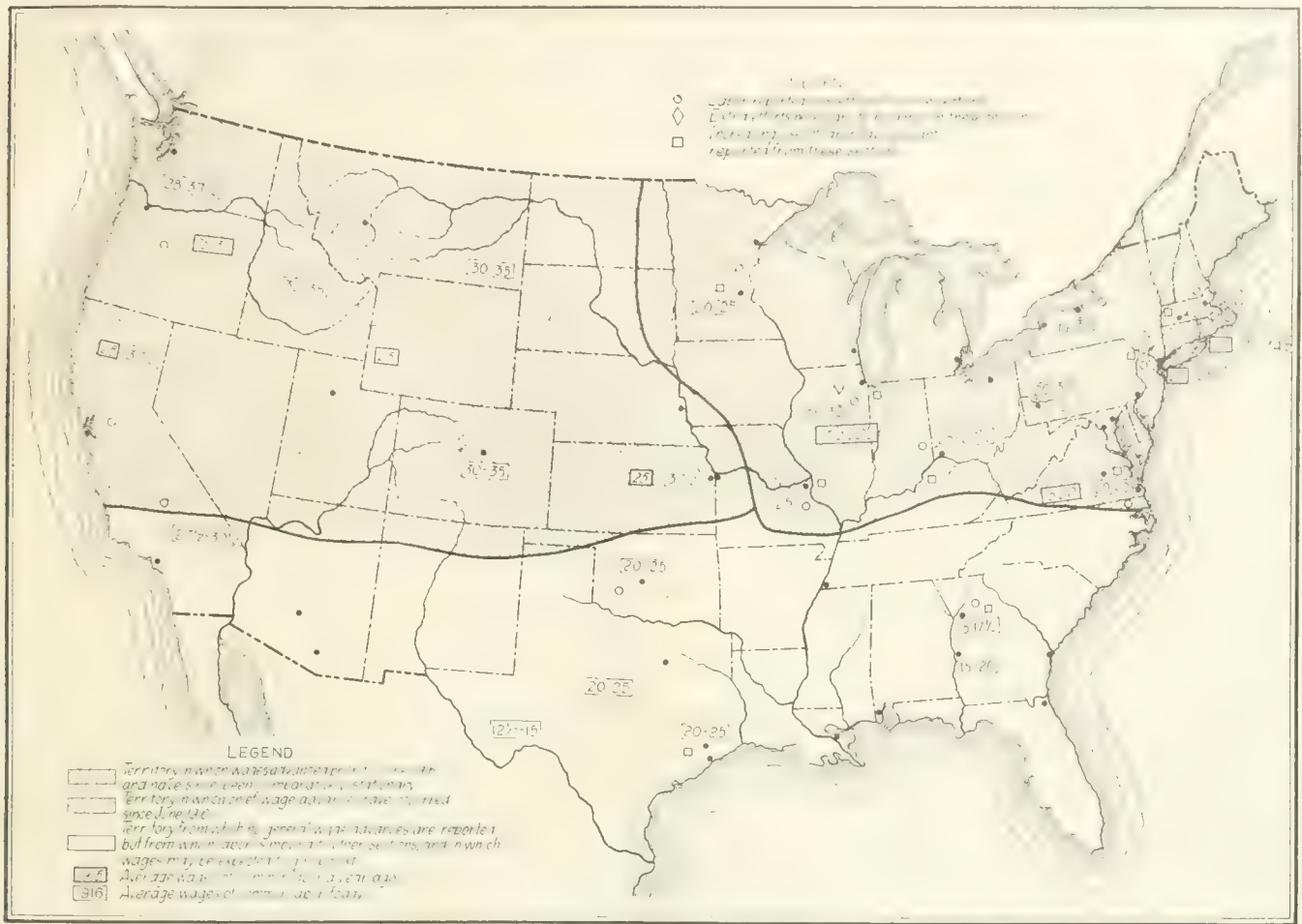
of the Ferro-Concrete Construction Company, W. A. Rogers of the Bates & Rogers Construction Company, W. O. Winston of the Winston Brothers Company and I. G. Harmon of the Thomas-Harmon Company have reported that on construction work under their charge and observation the use of labor-saving machinery is on the increase. Several of these men and others in charge of organizations of similar size have gone further and stated that construction plant is being used to the fullest extent, and new contracts are being planned with the greatest care to reduce manual labor to a minimum. Of course, with firms engaged in building construction, as is brought out in replies from L. J. Horowitz of the Thompson-Starret Company and G. H. Hailey of the Cleary-White Construction Company, little improvement in this direction has been possible. The leaders in the building field have long planned all their operations with the best skill available, and seized on each new development in labor-saving plant as fast as its worth was demonstrated. Yet men in the front rank of this class of contractors are even now seeking new economies and scanning every horizon for developments that might be utilized with increased efficiency.

MEN'S WELFARE OF GROWING IMPORTANCE

Such efforts on the part of the leading minds in the construction realm to increase, even under adverse conditions, the ratio of finished work produced per unit of capital and effort invested are among the most hope-



PRESENT LABOR CONDITIONS SHOWN ON MAP ON NEXT PAGE WERE FORESHADOWED LAST MAY



LABOR SHORTAGE HAS EXTENDED OVER ALMOST ENTIRE COUNTRY—ONLY IN SOUTH HAVE WAGES REMAINED THE SAME AS BEFORE THE WAR

Were this map conventioned in the same way as that on the opposite page, the double-hatched area in the latter map would now cover most of the area shown hatched in the map above. Only in Texas and in the white area west of it is the labor situation at present such as to cause contractors no anxiety.

ful signs in the field of engineering. Of first importance in this connection are measures, forced on some and eagerly sought by others, for conserving and improving the efficiency of the working force. As many can testify to their sorrow, a general rise in wages tends to produce a directly opposite effect. Neither can the necessity for paying men's carfare to remote work, or for declaring more frequent paydays, reported by a number as now necessary to hold labor in their territory, be regarded as unmixed benefits. Better-conducted camps, however, such as the United States Reclamation Service has resorted to in an effort to increase the steadiness of its labor force, are bound to react favorably. Systematic efforts to give workmen continuous employment, even though forced on some contractors by the fact that men laid off are men permanently lost, certainly tend to raise the standard of efficiency.

One eastern operator, unable to secure timber men on a bridge contract, put experienced foremen on the job in the proportion of one to each two or three workmen, and has carried out the timber construction in this way with common labor. Action such as this—and other instances could be given—results in training a large number of men who in normal times would learn little more about the work on which they were engaged than how to push a wheelbarrow. It pays now

to retain the man that two years ago would have been dropped as worthless and to try to teach him something. The process may be painful to the instructor, and some immediate loss in efficiency can hardly be avoided. But when the present rush is over the construction business will probably emerge with a larger and better-trained force of workers, and an efficiency will be possible which will make up in the long run for present troubles.

THIS YEAR'S WORK TO TAX LABOR SUPPLY

Most of the contractors who replied to the inquiry hold that the labor shortage has already curtailed work and may be expected to have a more serious effect this year. Those who do not voice this opinion virtually agree with it by citing increased material costs and the difficulty of securing deliveries as factors in reducing the volume of construction. Both of these conditions, of course, are due in large measure to the general labor situation, of which the shortage in the immediate construction field is merely another result. While manufacturing plants are able to pay present prices for construction, and real estate operators are finding themselves in the same position, the railroads may continue to hold back. On the whole, however, as much construction work as can be carried on with the labor available is expected to come out in 1917.

Expanding Export Trade Emphasizes Need for Adequate Water Terminals

Public Ownership of Waterfront Essential—Factory and Warehouse Facilities, as Well as Rail Connections and Truck-Loading Space, Must Be Provided

By B. F. CRESSON, JR.

Chief Engineer, New Jersey State Board of Commerce and Navigation

THE EXPORTS of this country have increased tremendously during the European War and the indications are that our present foreign commerce will not only be maintained after peace has been declared, but is likely to increase. The factors which lead to this conclusion are the great number of new industries being created, and the expansion of old industries; the better industrial plants and equipment convenient to tidewater; the better organization of terminals; the better banking arrangements between this and other countries, and the general commercial exhaustion of Europe as a result of the war. With this expanded trade, the development of better railroad terminal systems at the principal harbors of the United States and the creation of more efficient and economic water terminals are of the very first importance to the United States.

Owing to the increased demand abroad for American products there has been a very marked tendency recently for industries to locate near the seaboard where exports can be made with as little delay and expense as possible. It is significant to note that in the State of New Jersey during the year between Nov. 1, 1915, and Oct. 31, 1916, the state was besieged with applications for its waterfront and during that year sold or leased frontage devoted exclusively to commercial and industrial enterprises amounting to more than \$506,000, far exceeding the sales of any preceding year.

The recent organization of a great international corporation for the extension of American industries and American shipping throughout the world and for the creation of terminals in this country is a further indication of present tendencies. The increase in American shipbuilding is another activity which points to the extension of the commerce of this country. During the first eleven months of 1916 the merchant ships built in the United States totaled more than double in tonnage the whole year's output in 1915.

WATER TERMINALS

The value of transportation systems to a community is measured largely by the terminal facilities. A railroad passing through a district is of no advantage to that district unless freight and passenger stations and sidings are provided. A waterway or a canal is valuable to a community as a means of transportation only when bulkheads or wharves are provided against which boats may dock. Terminals in congested areas are the expensive parts of the railroad systems, and the expense at some of the principal railroad centers in the country is increasing rapidly and is a great burden upon the finances of the railroads.

In the absence of a joint terminal system in a com-

munity, the railroads are developing individual terminals, the best that they can possibly provide in order to attract business to their lines. Competition in rates has been eliminated and competition in terminals at important centers is the greatest competitive condition that remains. Where there are individual terminal systems the road with the best can be reached most cheaply by the shippers and can usually, by the larger volume of its business, make quicker shipments and deliveries. These conditions tend to attract business to them.

At tidewater the competition between the railroads for terminals is most keen, and especially is this the situation now when there is so great a volume of export business. Individual terminal systems at seaports are very expensive and the time is not far distant when their increasing expense will drive the railroads to combine on jointly operated terminal systems. This is particularly the case at New York, where one general terminal system, including waterfront facilities and lighterage equipment, with a union belt line would work economy in the cost of operation and in the use of the waterfront.

It has been the policy of some of the railroads owning waterfront at important seaports to build piers and to provide practically free wharfage for ships in order that the railroads might handle the cargo. This is an injustice to other roads not having such piers. It is an injustice to private pier owners, and more than that, it is an injustice to the communities bordering on the waterfront which are building wharves and docks to increase the commerce of the community.

BETTER WATER TERMINALS

Thoughtful men realize that monopoly by private interests of important waterfront is a public menace, and public sentiment is gradually being directed toward the impropriety of permitting the waterfront in congested localities to be manipulated and operated for private profit. The sentiment is, therefore, developing in favor of the ownership by the public of the waterfront and of the waterfront facilities. The waterways are essentially public highways and as such the public is entitled to reach them on reasonable terms and with as great convenience as possible. The value of water terminals to a community is not measured by the rentals which may be received from their use; the convenience and the cheapness of the terminal facilities are of the utmost value in making the port attractive to commerce and thus encourage industries to locate near by and increase the population of the community. This can best be done by eliminating private profit which must be obtained in private waterfront terminals.

The municipality can get its money cheaper than a

private corporation. It needs to get only enough return to provide interest on the investment and a sinking fund, and therefore fundamentally it should be cheaper for commerce to be handled through public than through private terminals.

Public ownership does not necessarily mean public operation. An arrangement could be made whereby a publicly owned water terminal might be operated under contract and with public supervision, by a private operating company, which would guarantee as rental the interest on the public investment, with a provision for profit sharing. This can be conceived as a most efficient and attractive plan.

FOREIGN EXPERIENCE

The public port policy has developed very greatly in Europe, where now at the great seaports the waterfront and the terminal facilities, including the railroads, are usually publicly owned and controlled and often publicly operated. This lesson has been learned slowly, and it was not until 1908 that London, which has been for centuries the greatest seaport in the world, finally determined that it must terminate the private ownership and operation of its docks and terminal facilities, or see commerce gradually leave the port and go elsewhere. The Port of London Authority was therefore created by Parliament and was given more than £27,000,000 to take over the privately owned waterfront and terminals. It was given full power to operate the docks and the accessories, and the plants of the private corporations, such as the London & India Docks Company, the Surrey Commercial Dock Company, the Millwall Dock Company and some others were bought out and taken over by the port authority and are being operated as a public trust. We are gradually coming to a realization of the situation in this country.

There is need in this country, especially at the Port of New York, through which passes more than half of the foreign commerce of the United States, for better water terminals in order to facilitate the exchange of commodities between land and water carriers. There are but few instances in the large American ports of properly designed, built and operated terminal facilities. The expense and the delay as well as the confusion of transshipping of commodities between rail and water carriers have been largely responsible for the blockades of freight and for the embargoes. This condition has hurt everyone, the railroads, the ships and the shippers.

PROPERLY ORGANIZED WATER TERMINAL

A water terminal is a good deal more than a pier and a shed and a railroad track. To be thoroughly economic it must provide sufficient wharfage to accommodate a considerable number of ships, in addition to lighters and barges which are incident to business in a harbor. There must be sheds for the protection of cargo in transit, where cargo may be assembled in advance of the arrival of ships and where cargo from the ships may be held awaiting transportation inland. There must be warehousing accommodations convenient and accessible both to the railroads and to the ships. These are necessary, as it develops that some freight must always be held for a considerable period awaiting a favorable market or for some other reason.

Railroad facilities are of the greatest importance in

a water terminal and a sufficient railroad yard must be laid out near the entrance to this terminal to which access can be had at reasonable rates from all the railroads doing business in its territory. From this yard rails must lead to the bulkheads, where the interchange of cargo may be made with ships, and the rails must also lead to warehouses, to local freight stations and to industrial buildings. The greater the volume of railroad freight in any terminals the greater will be the dispatch with which shipments can be made. Where there is a great volume of freight there is not the necessity for holding it awaiting cars for destination.

AUXILIARY FACILITIES

Cold-storage facilities should be provided to take care of perishables in their exchange between rail and water carriers. There should be sufficient upland available so that industries can take advantage of the proximity to water and rail transportation and to the markets of labor and materials which are normal to important terminal points.

In a harbor such as New York, with its parts split up by waterways and with the lack of intercommunication by rail between its boroughs, a clearing house for freight should be provided where freight that is to be or has been lightered may be received and classified and sent away without congesting other parts of the terminal.

Where a terminal is near a great industrial center the motor truck must be taken into consideration and a clearing house should be provided to handle the motor-truck business very much along the same lines as a railroad handles its business through its classification and assembly yards.

A well-designed water terminal should include also facilities for a public market, where produce, meats and other food products can be received in bulk, either by rail or water, and can be distributed direct to the consumer. This would eliminate the middleman to a marked degree.

As a general proposition, the bigger the water terminal and the more facilities it possesses the better and more economical will be its operation.

DESIGN AND CONSTRUCTION

In the proposed marine terminals at Bayonne and at Camden, N. J., which the writer has designed, multiple-story sheds have been placed along the bulkheads at certain intervals in the Bayonne layout, and along most of the bulkhead in the Camden layout. In the particular plans mentioned, the structure has three stories, the first or lower floor being for the handling of cargo in transit between ships, railroad cars and trucks, and the second and third floors for the longer time storage of commodities; it is located alongside of ships and with direct access, through elevators or hoists, to railroad cars and trucks.

With such an installation it seems that material economies may be effected, especially in the saving of drayage between the carriers, either land or water, and the warehouses. Here is a combination of land and water transportation and of long and short-time storage and warehousing within one unit.

Multiple-story structures along the waterfront and on piers are believed to possess substantial advantages

and will, no doubt, be resorted to specially in localities where the waterfront is very expensive and where a large volume of cargo is handled. It is not believed that more than three or four stories would be feasible, especially on a pier structure extending out into the waterway. The congestion at the shore end of such a structure would probably be excessive with more than three or four stories, and the question of foundations might be difficult.

SUBSTRUCTURE

General types of construction are governed largely by the locality and the general form of the terminal. Massive masonry or concrete bulkhead walls may be constructed; timber bulkheads with bulkhead platforms may be used or structures may be built entirely on piling. In localities where the marine borers are not active, as in the principal parts of New York harbor, untreated timber-pile structures appear to be the most economical, the life of untreated piles on the North River being from 20 to 30 years.

In localities where marine borers are moderately active the writer favors timber construction, with the timber creosoted where it will be difficult and costly to renew it. There are certain localities where the activity of the marine borers is such that timber even though well creosoted or protected cannot be depended on for any length of time, and at such places consideration must be given to the use of masonry or concrete.

Masonry makes a splendid job, although its lack of elasticity may be considered a disadvantage, and it is very expensive.

Reinforced-concrete dock work is expensive and there may be the danger (unless the design and carrying out

of the work are first class) of disintegration through cracking under the impact of heavy vessels, especially in cold climates.

The elasticity of a timber structure where heavy boats are to dock is an important factor in its favor.

The question of fireproof construction of pier sheds and buildings for the storage of cargo on the waterfront is an important one, but it seems unwise to spend much additional money for fireproof construction. The highly inflammable character of much of the commodities which pass over the waterfront makes it seem more desirable, instead of attempting to construct fireproof buildings, to install a full and complete system of automatic sprinklers. A pier shed acts much like a chimney in case of a fire and it is the cargo that burns.

CONCLUSION

The writer is strongly of the opinion that the seaports of this country must build water terminals of more economic design and of greater business scope and capacity than those which have been built in the past; that it will well pay communities to do this, because of the commerce which will be attracted by better and cheaper facilities; that jointly operated terminals must be substituted for the expensive individual systems now operated by the railroads at important centers; that the policy of public ownership of terminal facilities must be extended, thereby cheapening their operation; that public moneys freely spent on carefully thought out terminal plans will pay the communities the investment many times over by the increase in population and industries, with the consequent increase in rateables.

Activated-Sludge Process of Sewage Disposal Firmly Established

Experimental Work Has Solved Most Problems—Sludge Dewatering Still an Economic Problem—Enforced Supervision of Plants Augurs Well for Engineers

By T. CHALKLEY HATTON

Chief Engineer, Sewerage Commission of the City of Milwaukee

ENOUGH has been learned about the activated-sludge process of sewage disposal to warrant certain municipalities in seriously considering this process and comparing its results with other processes now in common use before a choice is made. To expect that it will take the place of all other processes for treating sewage is a mistake. Standard of effluent required and economic conditions in each case will be the deciding factors in making the choice. These may be favorable to the activated-sludge process in the small as well as in the large municipality, although the latter will always have the advantage because sufficient sludge will be produced to warrant the cost of the reduction to a fertilizer, whereas in a small plant this cost may be prohibitive.

In making any choice, however, these facts must not be overlooked—that in all processes of sewage treatment where tanks are used the disposition of the re-

sultant sludge is a constant and ever-increasing nuisance and expense; that the activated-sludge process produces a sludge which is far more valuable as a fertilizer than any of the well-known processes, and that there is ample market available for it when reduced to proper form.

LOCATION OF PLANTS

During the year just ended considerable progress has been made toward solving the problems connected with the process. Important experiments have been carried on at Urbana, Ill.; Lawrence, Mass.; Baltimore, Brooklyn, Cleveland, Regina, Sask.; Toronto, Milwaukee, Armour and Swift, and the Sanitary District of Chicago. Besides these, investigations have been conducted in a more or less systematic manner by the boards of health of several of the states.

An activated-sludge treatment plant having a capacity

of about 1,500,000 gal. per day has been built at Escanaba, Mich. The septic tanks operated for many years at Champaign, Ill., have been improvised into an activated-sludge plant to treat about 500,000 gal. daily. Regina, Sask., has a plant in operation treating a part of its sewage, and the largest plants, one capable of handling 12,000,000 gal., and the other 6,000,000 gal. per day, are now being built at Houston, Tex. A plant for treating the sewage of Lima, Ohio, during the summer months has been recommended, and one for treating the sewage of Mattawan, N. J., has been designed and approved. Milwaukee is now engaged in designing a plant for treating 130,000,000 gal., normal flow, per day.

WHAT HAS BEEN DETERMINED

From the evidence to date it appears that this new method of treating sewage has aroused widespread interest in America, that it has come to stay and that, if tanks are properly designed to meet conditions favorable to the process it will place the problem of sewage disposal in a more satisfactory situation than it has heretofore attained.

Considering the problem from the viewpoint of the average municipality, many of its phases have already been solved, others more or less satisfactorily, and some not at all. It has been proved beyond any doubt that the aëration of raw sewage in the presence of well-activated sludge for a certain length of time will separate the suspended and colloidal matters, induce rapid precipitation and produce a clear, non-putrescible effluent. The character of effluent produced depends on the character of influent, the volume of air applied, the period of application, the temperature of sewage treated, and upon the period and method of sedimentation.

A clear and non-putrescible effluent can be produced at rates of from 7,000,000 to 10,000,000 gal. per acre per day, including all area needed for aëration, sedimentation and sludge-settling tanks.

The process produces a sludge containing from 4 to 6 per cent of available ammoniacal nitrogen, which has sufficient value as a fertilizer base to warrant the cost of its reduction, and the volume of such sludge produced depends on the amount and character of the suspended matters in the raw sewage. Neither flies nor objectionable odors are produced by the process.

LIME NOT NECESSARY FOR DEWATERING

The sludge can be successfully dewatered by more than one method, without the addition of lime, reduced to fertilizer base and disposed of at a net cost, at most no greater than the cost of disposing of sludges produced from other treatment processes. There is ample market for the sludge when reduced to a fertilizer base.

Satisfactory diffusion of the air through the sewage can be accomplished by at least three methods: (1) Through perforated pipes laid in the form of grids near the bottom of the aërating tanks; (2) through Filtros plates built into the bottom of the tanks, and (3) through wood plates made up from porous wood about $\frac{1}{2}$ in. thick and sawed cross-grain.

Sedimentation is effected in from 40 to 50 minutes' detention period in either vertical or horizontal-flow tanks, or by a combination of both.

While there are many other interesting features already solved, the ones enumerated are perhaps the most important. The following features are not yet satisfactorily determined, although considerable investigation is going on to that end:

1. What influence the depth of liquor in the aërating tank has upon the volume of air and period of aëration required.

2. The most economic method of diffusing the air through the aërating tanks and the influence baffled tanks may have upon the aërating process.

In this connection it might be well to state that it has been satisfactorily demonstrated that Filtros plates do not become stopped up on the under surface provided the air delivered is kept free of oil and dust. These foreign matters can be eliminated by washing the air before or while it passes through the blower and by installing a type of blower which excludes all oil from inside the blower casing.

AIR REQUIRED PER GALLON

The present evidence indicates that it requires from 1.5 to 2.0 cu. ft. of air to treat a gallon of sewage containing 325 parts of suspended solids per 1,000,000 gal. in a tank carrying 10 ft. depth of liquor, when the sewage has a temperature of 50 deg. Fahr. and upward. Below this temperature about 50 per cent more air is required. Cleveland is procuring a clear effluent from sewage containing about 250 parts of suspended solids by using from 0.7 to 0.9 cu. ft. of air per gallon of sewage in a tank carrying 15 ft. depth of liquor.

It is felt by those engaged in studying intensely the air problem that a large reduction in air requirements will be possible with improvements in diffusers and tanks.

What economic advantage can be secured by aërating the activated sludge before returning it to the aërating tanks is a matter not yet determined. Cleveland is experimenting upon this feature now. The Houston plant has been designed to reaërate the sludge through about twice the period that the sewage is to be aërated.

TYPE OF SEDIMENTATION TANK

The proper type of sedimentation tank is still problematical. Experiments so far indicate that surface area and depth have little influence. As soon as the mixture of liquor and sludge becomes quiescent the latter rapidly flocs and settles at the rate of about 1 in. per minute. The lighter particles of this floc are so near the specific gravity of the liquor that any cross-currents accelerating the velocities in the sedimentation tank induce them to rise and again mix with the liquor; so that it appears to be highly important to maintain a uniform velocity through the tank. Horizontal velocities of 3 ft. per minute and vertical velocities of 8 ft. per hour have been found satisfactory.

The disposal of the resultant sludge has been one of the most vital features of the problem and has been studied in greater detail at Milwaukee and Cleveland than at any other points. While it has been satisfactorily demonstrated that this sludge can be dewatered by several methods the most economic one, and its cost, is still to be determined.

At Cleveland the dewatering has been done by a centrifuge of the inclosed laundry type, and also by drying

on lids enclosed in glass roofs, the residue being destroyed by incineration. The cost has not been determined.

At Milwaukee the moisture content has first been reduced from 99 to 96 per cent by settling 1 hour or more, then further dewatered to 75 per cent moisture by pressing through a Berrigan filter press and a Simplex plate press, the former manufactured by H. R. Worthington of Harrison, N. J.; the latter by the Simplex Ejector Company of Chicago.

FOUR TONS OF SLUDGE CAKE PER DAY

Either of these presses will produce about 2000 lb. of cake in 5 hours, or about 8000 lb. per day of 24 hours. The sludge is easily handled, has no objectionable odor and can be stored without nuisance.

The sludge cake has been further dewatered to contain from 5 to 12 per cent moisture by means of either an indirect steam dryer of the Smith type or a direct heat dryer of the Buckeye type, after which it is ground up to seeding size by either the Williams or Stedman mill. The amount of cake thus dewatered depends upon the type and size of dryer used.

Other methods of dewatering the sludge are being investigated and with great promise. The most expensive portion of the dewatering process, as carried out in Milwaukee, is the pressing to reduce the moisture content from 96 to 75 per cent. This expense embraces labor, filter bags and large overhead. If the Dixon yeast process, as now being tried out in Brooklyn under the inspection of George W. Fuller, proves economical in reducing the moisture to at least 85 per cent, the material can be further dewatered by a direct heat dryer, without pressing, at much less cost. Cattle manure, containing from 85 to 90 per cent moisture, is being very successfully and economically dewatered at Armour & Company's feeding stations at Peoria, Ill., and at St. Louis by the Buckeye direct-heat dryer.

SLUDGE COSTS AND VALUE

The cost of dewatering the sludge depends upon several factors—the size of plant, price of fuel for drying, power costs and the cost of labor. At Milwaukee, where an average of 40 tons of dried material will be produced per day, the cost of dewatering, grinding and storing, if the apparatus already experimented with is finally used, will be from \$6 to \$8 per ton, based on a final product containing 10-per cent moisture. This cost includes all overhead charges, such as interest, sinking fund and depreciation, not only upon the apparatus, but upon the buildings required for their housing.

The market value of the ammoniacal nitrogen in the sludge ranges from \$1.75 to \$3.50 per unit, or from 83½ cents to 17½ cents per pound. The Milwaukee sludge averages 4½ per cent of available ammonia after the drying process has been completed. Therefore it appears that if the cost of reduction is the maximum and the value is the minimum the sludge can be disposed of without cost to the city. On the other hand, if averages are used in both cases a net profit of approximately \$5 per ton will be realized for the city. In either case the results will be a great step forward in the art of sewage disposal.

The cost of constructing an activated sludge plant

will vary according to local conditions. Three complete plants are now in course of construction.

The Escanaba plant will cost, according to present contracts, \$40,000, including sludge reducing apparatus, or \$27,000 per million gallons. The conditions under which this plant is being built are rather unusual. The excavation is being made through water-bearing sand, there being a static head of 24 ft. upon the bottom of the excavation, thus increasing the cost materially. The estimates for the two Houston plants were \$128,000 and \$250,000 respectively. The present contracts, which embrace the building of all the tanks, piping, etc., but not the machinery, call for an expenditure of \$82,602 and \$186,549 respectively, or about \$13,100 and \$15,500 respectively per million gallons. Estimating power and machinery worth \$60 per horsepower, and sludge presses and dryers with transmission equipment at \$7000 per million gallons, the total cost of the Houston plants will be approximately \$22,200 and \$24,600 per million gallons, exclusive of land and engineering.

Careful estimates have been made of the 130,000,-000-gal. plant for Milwaukee. These indicate a cost of \$25,000 per million gallons, which includes buildings and sludge reducing plant and excludes land and engineering. This plant is to be built into the lake upon pile foundations, thus making the cost unusual.

AIR COSTS

The largest share of the operating cost of the process is represented by the amount of air used. This depends upon the cost of power, which varies largely throughout the country. In making estimates for the cost of air it appears to be safe, from present knowledge of the process, to allow for using 2 cu. ft. of air per gallon of sewage treated compressed to 6 lb. pressure when using 10 ft. effective depth of water in the aerating tank, and basing the volume of air required upon the daily average flow of sewage plus from 5 to 10 per cent for sludge air-pumps.

The percentage of activated sludge kept in contact with the liquor during the aerating period may vary from 15 to 25 per cent without seriously influencing the process. The adaptability of the process to local conditions is perhaps greater than any other yet discovered because any standard of effluent can be produced by varying the volume of air, the period of aeration and the volume of activated sludge.

PROCESS FORCES SUPERVISION

Intelligent supervision of operation is to be desired to get the most economical results. This feature should commend the process to the members of the engineering profession engaged in sewage-disposal problems and management. They appear to be convinced that the successful operation of a sewage-disposal plant, no matter what process is installed, requires as careful supervision as water purification or garbage disposal.

It is a fact well recognized by engineers who have opportunities for visiting the sewage-disposal plants for small municipalities throughout America that few of them are producing an effluent anywhere near the standard for which they were designed or could produce under competent supervision. This condition is largely due to the tendency of engineers to build works

which might be expected to operate automatically. The character of the average sewage is too complex to do this successfully. The existing conditions are vividly portrayed in the recent report of the committee on sewage-works operation of the American Public Health Association. It appears that of the 1294 sewage-disposal plants reported to the committee only 61 were supplied with the necessary equipment and trained men for proper operation; and, while each of the 48 states had boards of health which should have the legal power and trained men to require sewage-disposal plants to be operated to meet the purpose for which they were built, only 15 states in the Union were endowed with such powers.

To quote from this report, one correspondent states, "Our municipal sewage plants have practically no supervision either by the state board of health or by local authorities We have even found cases where local authorities were doubtful as to the location of the plant."

Under such conditions is it any wonder that sewage

disposal in the United States has been a record of disappointments and failures? And is it not high time for engineers to realize that a necessary requisite for all plants is continuous and enforced competent supervision?

The activated-sludge process requires certain moving machines, and thus becomes comparable to a municipal water plant. Every municipality gives fairly good attention to its water plant not only to secure as good water as possible, but to protect its high-class machinery. Sewage disposal by this new process will, for like reasons, enjoy competent supervision, and to that extent at least is an improvement upon most of the present methods of sewage disposal.

The experimental work now being conducted cannot be expected successfully to solve all the problems connected with the process. It has solved what might be considered the basic features, but, like all other newly discovered arts, perfection can only be attained by actual development of working plants under varied conditions.

The Motor Truck and the Road

Vehicle and Highway Must Be Considered as One Problem—Indications Are That 6-Ton Load-Carrying Capacity Will Be the General Maximum

By NELSON P. LEWIS

Chief Engineer, Board of Estimate and Apportionment, New York City

HUNDREDS of millions of dollars have been expended and many millions more will be spent within the near future in the improvement of roads in urban, suburban, and rural districts. The demands for road improvement have been greatly stimulated by the change in the character of vehicles using these roads, and much study is being devoted to the problem of the adaptation of roads to the character of vehicles using them, while some consideration, but not enough, has been given to the adaptation of the vehicles to the roads. Painstaking investigation as to the character and use of road material is important. Improvements in the type of vehicles which are to use our highways, in order that the cost of maintaining the roads as well as that of transportation on them may be reduced to a minimum, are also important, but these are so closely related that they may be considered two phases of a single problem. They are intimately connected and should be studied together, while careful consideration should also be given to intelligent regulation of traffic in order that the general public may receive the greatest possible benefit from the investments already made and yet to be made in highway improvement, and in order that this investment may have the greatest possible permanent value.

Attention is now being given to weight of vehicles, to their length and width so far as they affect the use of roads, and these are the factors it is proposed to discuss in this article.

The type of construction which generally prevailed a decade ago, when roads were chiefly used by horse-drawn vehicles and by relatively few motor vehicles, and these for pleasure traffic, is not suited to the traffic

to which roads are now subjected. They must not only be provided with a surface adapted to fast-moving motor vehicles, but they must also have sufficient strength to carry the loads imposed upon them by commercial vehicles or motor trucks. They must also be of such width as to accommodate the increased size of vehicles of the latter class. While the need of substantial pavement foundations in city streets, which were likely to be subjected to very heavy loads, has long been recognized, rural highways are now called upon to carry loads which approximate those heretofore found only in populous centers.

GREAT INCREASE IN STREET TRAFFIC

The volume of traffic on city streets has greatly increased of late, and it has frequently been stated that the capacity of our city streets would have to be increased either by the widening of roadways or by the creation of new thoroughfares. The trouble has been that traffic has not been well distributed. There is undoubtedly an enormous surplus area of pavement in all cities, but, while certain streets are greatly overcrowded, others are almost deserted. This is due to two causes, namely, the persistence with which traffic will follow a route once established and with which drivers are familiar, and the lack of generally well-paved streets. If the latter trouble were remedied, the former difficulty would soon solve itself. While this is true with respect to both pleasure and commercial traffic, it is conspicuously the case with respect to the former, as additional distance is of little moment to the driver of a pleasure vehicle who would gladly go half a mile or a mile further if by so doing he could follow a more

agreeable route, both with respect to pavement surface and attractiveness of surroundings. It is with the commercial traffic or the motor truck that this discussion will deal.

WEIGHT TENDENCIES OF TRUCKS

The increasing weight, load capacity and size of motor trucks have been matters of grave concern to all who are responsible for the construction and maintenance of public highways. While numerous instances could be cited of excessive and unreasonable loads, for the support of which the public should not be called upon to make provision, let us see what is the tendency in this respect at the present time.

The increase in the number of commercial vehicles is obvious to the most casual observer. The registration of such vehicles in the State of New York during the three months following Feb. 1, 1916, exceeded the total registration for the year 1915. The review published in the *Commercial Vehicle* early in 1916 indicated that there were no less than 221 manufacturers in this country who are offering vehicles of this kind. Of this number, 133 appeared to confine themselves to those of less than 3 tons capacity. Of the remaining 88, 58 appeared to have made no changes in the maximum capacity of their models for 1916. In 44 cases the maximum capacity was 5 tons or less. Nine of the manufacturers offered trucks of a maximum capacity of 6 tons, one 6½, one 7 and three 7½ tons. Twelve of the manufacturers increased the maximum capacity of their trucks, only two of them, however, reaching a maximum of 6 tons. On the other hand, six manufacturers decreased the maximum capacity of the truck offered, one of these from 6 to 4 tons and another from 7½ to 5 tons. The list indicated that there were twelve newcomers in the field, of whom but two offered trucks with a maximum of 5 tons and one with a maximum of 6 tons. The popularity of the 3½-ton and 5-ton trucks is evident from the statistics, a number of manufacturers having adopted them as their maximum.

Six of the largest makers of motor trucks, one organization dealing with the technical problems of their design and one devoting itself to the promotion of their use have given the writer their opinions as to the probable economic limits of weight of truck, load capacity and load on rear axle. The maximum weight of truck is estimated at from 10,000 to 12,000 lb., the load capacity from 10,000 to 16,000 and the load carried on the rear axle from 16,750 to 24,000. The load per inch-width of tire is estimated at from 600 to 800 lb.; and it is noted that this limit is due to the inability of rubber tires to sustain a heavier load, while the effect of concentrated loads upon the wearing surface and foundation does not appear to have been considered.

PROBABLE MAXIMUM

There seems to be a rational basis for the prediction that the maximum limit of truck capacity will be about 6 tons, as a careful analysis of the ton-mile cost of moving material by motor truck indicates that this cost reaches a minimum in the case of a 5-ton truck at a speed of 9 miles an hour or a 6-ton truck at 8 miles an hour. The cost per ton-mile of a 10-ton truck at 5 miles an hour is materially greater, while that of a 1-ton truck at 15 miles an hour is very much greater. All

of these estimates appear to have been predicated upon 5 hours of actual running during the day. All the manufacturers who have supplied the foregoing information say that there will be special cases where heavier loads could be carried advantageously if the state or city regulations will permit, and all estimate the speed capacity of trucks to be considerably above that which is most economical, while they state that on well-paved streets grades up to 15 or 18 per cent can be overcome.

WIDTH AND LENGTH

A consideration of the utmost importance, especially in the case of city streets, is the size of the vehicle, more particularly its width. The manufacturers and others whose opinions with respect to loads and speeds have already been referred to have indicated that the wheelbase varies from 12 ft. 6 in. to 17 ft. 4 in. and the overall length from 22 to 28 ft.; that the gage between centers of tires is from 5 ft. 10 in. to 6 ft. 3 in., and the overall width, including load, from 7 ft. 4 in. to 8 ft. It is stated that, while these will be the probable limiting dimensions, special loads, such as plate glass carried flat, may exceed the above cited overall widths in a few instances.

The effect of increasing width of vehicles and loads on curbed city streets will be very serious, as it will tend to reduce the number of lines of traffic which can use them. If a curbed roadway is designed to provide for four lines of traffic and if, as a result of increasing the width of loaded vehicles, it can accommodate but three lines, the capacity of the street will be almost cut in two, as the third line of traffic, being obliged to accommodate vehicles moving in both directions, will be of little use. On rural highways the increasing width of loaded vehicles may not be so serious in its consequences, yet it will retard traffic owing to the danger of passing, while it has already resulted in a tendency to increase the standard width of rural highways from 15 to 16 to 18 and, in some cases, to 20 ft.

TRAILERS

The increase in the use of trailers has caused some anxiety to highway officials. One of the manufacturers referred to has stated that one trailer may be used in city streets, resulting in a total length of truck and trailer of 40 ft. Another expresses the belief that three trailers may be used with a total length, including the truck, of 50 ft. Another notes that with a tractor loads of 15 and 20 tons can be hauled, and with a tractor and two or more trailers the load capacity is limited only by the power of the tractor and the ability of the load to sustain its weight; while still another observes that "it is entirely feasible to construct road trains in which the trailers will follow practically in the path of the tractor, also to have the tractor generate electricity which will be used in driving motors on the trailers, thus making it feasible to operate a road train as long as an ordinary railroad train."

It is probably safe to say that the use of one trailer in city streets and possibly two on thoroughfares that are not congested will involve no serious difficulties so far as the obstruction of the street is concerned, and that on rural highways the number may be increased, though not to the extent indicated in the foregoing quotation. Trailers now are designed to follow the tractor

without cutting corners, so that one of the chief objections to their use has been eliminated.

REASONABLE RESTRICTIONS

The need of reasonable restrictions as to the wheel loads permitted on public highways is generally recognized. As already stated, manufacturers of motor trucks have estimated the maximum load per inch width of tire at from 600 to 800 lb. in the case of rubber tires, and such loads will probably have no serious effect upon city pavements or upon rural highways of the type now being constructed in many states, but the steel tire on both truck and trailer, frequently carrying a load per inch width far in excess of that named, is an engine of destruction which has played havoc with many highways.

The great advantages of the motor truck over horse-drawn vehicles and the extraordinary developments which have taken place in its manufacture make it quite evident that it must be reckoned with in the design and construction of our highways. It should not, however, be taken for granted that the adaptation of the one to the other is the obligation solely of the highway authorities, but that the obligation is mutual. In other words, while every effort should be made to provide highways suitable for the use of mechanically propelled vehicles, the manufacturers of such vehicles should devote the skill which they have already shown in their manufacture to adapt them to existing roads

and those which are now being constructed. It is necessary that the public authorities should also take a hand in solving this problem and should impose such reasonable restrictions upon the use of public roads as will be necessary for the protection of all road users and of the enormous investment of cities and states in highway improvement. Regulations imposing positive limitations not only upon the total wheel loads and the load per inch width of tire, but also upon the total width and length of vehicles which may be registered, as have been adopted by the State of Pennsylvania, seem reasonable and necessary. Such regulations may also provide for the imposition of a special fee, increasing with the load per inch width of tire and with the total width of vehicle and load, and the justice of such graduated fees can scarcely be denied.

Regulations of this kind, whether they involve the imposition of graduated fees or an absolute prohibition of vehicles having more than specified dimensions or wheel loads, should not be adopted hastily and should not be the result of a guess or of snap judgment. Important elements which should be considered in the framing of such regulations, but which are often overlooked, are wheel diameter and speed. These appear to have been considered in the Code of Regulations now under consideration in New Jersey (see Engineering Record of October 28, 1916), but it is important that they be expressed in a form so clear and simple as to be readily understood.

What Motor Trucks Offer to Contractors

Specialized Gasoline Machines Have Been Developed for a Wide Variety of Construction Purposes—Electric Trucks Need Investigation

By ARTHUR J. SLADE

Consulting Engineer, New York City

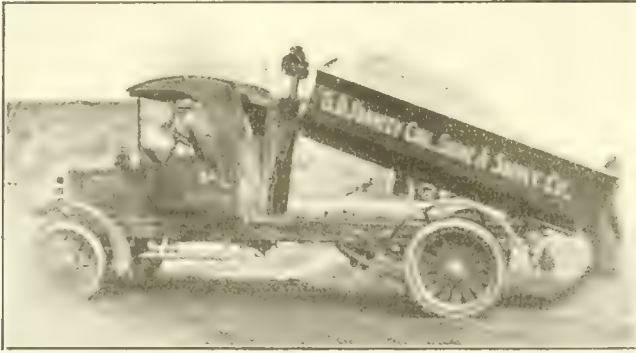
TO the intelligent observer of modern engineering development it may appear surprising how little the engineering construction interests have adopted and used motor trucks. Commercial lines of business have for some years successfully used them in competition with horse-truck, railroad and steamboat service. And yet interests which have the broadest knowledge and fullest experience in the application of mechanical devices have not, to the same extent, availed themselves of this type of equipment. This modern transportation system lends itself to a diversity of applications. It is free from the adverse effects of varying climatic conditions, requires little in the way of plant equipment for its maintenance and operation and can be operated at high pressure for long periods to an extent which is possible in few other transportation methods available for engineering construction operations.

MOTOR TRUCKS FOR CONTRACTORS

The American contractor has a reputation for ingenuity and progressiveness which would suggest his being among the earliest and largest users of such time and money-saving appliances. Why, therefore, is he actually one of the most recent and least extensive motor-truck users?

The answer is not difficult to any one who has been in touch with engineering construction, on the one hand, and motor-truck development on the other. The contractor applies to his operations mechanical and other devices often ingeniously combining comparatively unrelated units in an inventive manner, the result being a peculiarly efficient and suitable combination to perform the work in hand. Few, if any, contractors have designed their own steam shovels, electric plants or concrete mixers, but such individual units, however, have been built primarily for contractors' use. Had trucks, designed and built especially for contractors' use, been offered on the market at an earlier date, their inclusion in the contractor's plant would obviously be more general at the present day.

It should not be concluded, however, that the motor-truck interests were remiss in their recognition of the contracting industry, or that they are only now becoming aware of this great market. The development of the present-day motor truck was fraught with difficulties, obstacles and setbacks which, to put it mildly, were disheartening to many and disastrous to some. As in probably most pioneer developments, both moral and financial courage were required, since the product of the early efforts to produce motor trucks of a prac



1—SEVEN-TON AUTOMATIC DUMP TRUCK WHICH SAVED ALMOST \$1,000 IN TWENTY-FIVE DAYS



2 HAND TRIMMING ON ROAD WORK IS LARGELY ELIMINATED BY THIS METHOD OF SPREADING

tical type was regarded variously with contempt, derision or incredulity. Moreover, it should be recalled that scarcely a decade covers the period between crude experiment and successful achievement and universal recognition. It was quite natural, and in fact practical, for the motor-truck pioneers first to build machines for use in those lines in which the largest market was likely to be found, and to which the experience of the pleasure-car field could be most readily applied. For these reasons vehicles of comparatively light carrying capacity, intended primarily for use on city streets or good roads, were first perfected.

SPECIALIZED MACHINES DEVELOPED

Later the specialized machines were made possible by reason of added experience both in design and manufacture and the introduction of new materials of construction. The adoption of automobile-engineering standards and the manufacturing in quantity of component parts by so-called "parts manufacturers" have also contributed in a large measure to increase in quality with reduction in manufacturing cost, thereby making an investment in motor trucks more attractive by reason of decreased first cost and maintenance expense. Furthermore, the designing engineers, being relieved of some of their responsibilities in connection with the production of conventional merchandise-carrying vehicles, were left more free to originate special machines, parts or accessories especially adapted to engineering operations. To-day an entirely suitable motor-vehicle equipment can be secured from any one of a number of manufacturers which will be adapted to perform its individual functions in full co-operation with the other mechanical units employed in the con-

tractor's plant; but the great variety in engineering projects necessarily suggests the desirability of a wise selection of the motor equipment in relation to type, capacity and general features of design.

TYPES OF TRUCKS

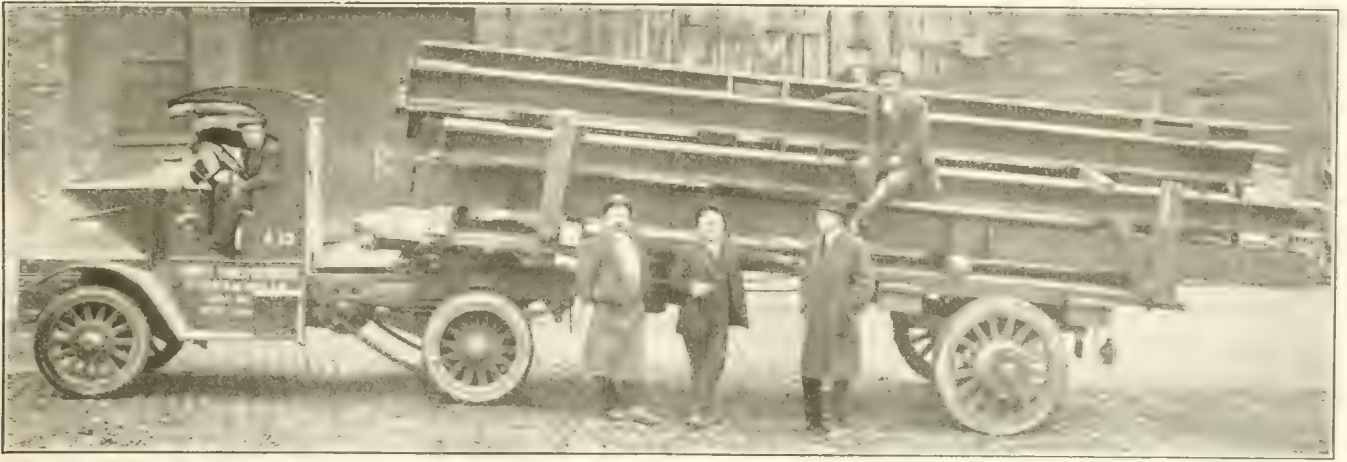
The most extensively used truck in general contractor's service is the gasoline-engine-driven four-wheel machine, propelled by the rear wheels and having a power or hand-operated dumping body. This type of machine is familiar to all, since its use is so general in all classes of business involving handling of material in bulk where quick dumping is desirable, and its economies can be enhanced by providing means for equally fast loading. Capacities at present run up to 7 tons, which is now generally regarded as the maximum desirable capacity for four-wheeled vehicles. The economies effected by the use of these dumping trucks of course vary widely in different localities and under various service conditions, and generalizations would be valueless. Photograph 1 illustrates a Sterling 7-ton automatic dumper operated in Milwaukee. During 25 operating days of 20 hours each in May, 1916, it effected a saving in haulage cost of \$985. Photograph 2 shows a similar truck distributing broken stone for road construction in Ohio, hand-trimming being largely eliminated by this method of spreading. It is therefore obvious that it is not always in haulage saving costs alone that these trucks are advantageous. A Garford 6-ton truck at Roxbury, Mass., was put on an excavation job which had become impossible for horses, and the use of the truck rendered unnecessary the installation of hoisting apparatus. Photograph 3 shows a Mack emergency and wrecking truck, just installed



3—EMERGENCY AND WRECKING TRUCK EQUIPPED WITH POWER WINCH AND REMOVABLE DERRICK



4—ON THE NEW YORK SUBWAY WORK PRACTICALLY ALL EXCAVATED MATERIAL IS REMOVED BY MOTOR VEHICLES



4—TRACTOR-TRAILER OUTFIT HANDLING LOAD OF SIXTEEN TONS OF STRUCTURAL STEEL

by the Boston Fire Department, equipped with a power winch, cable, a removable derrick, a drawbar for towing purposes, and other wrecking apparatus and tools. Its construction makes the truck a practical piece of machinery for the contractor, excavator and builder, as the winch can be utilized for hoisting the truck's load to upper floors and for lowering or removing material to and from excavations.

DEVELOPMENT OF TRAILER

When the haulage of loads is in excess of 7 tons per unit, or the character and dimensions of the loads render it desirable, the tractor and trailer equipment is available. Although originally an adaptation of the motor truck, accomplished by mounting the component parts on a chassis frame of reduced length and mounting a fifth wheel on the rear for the attachment of the forward end of a horse-drawn wagon, specially designed machines are now extensively used. Photograph 4 shows such a machine (a Mack tractor with a 16-ton load) handling structural steel. One of the Knox tractor and semi-trailer outfits is of a low-hung type, only 26 in. from the ground, and is designed for cut stone, curbing, machinery, etc. Several companies make a specialty of constructing such outfits for the solution of special problems.

The independent four-wheel trailer is a development of the past few years, and while not designed exclusively for engineering contractors is an extremely useful adjunct either to a four-wheel truck or to a tractor trailer. Photograph 5 shows a Knox tractor trailer and two 4-wheel trailers transporting concrete pipe weighing

20 tons. The heavy loads which the modern tractor is capable of hauling should be so distributed upon a sufficient number of bearing wheels, suitably tired, that no damage will result to the road surface or its foundation. While some outfits may have been built which have an injurious effect on roads, it is possible to construct a machine so that its effect on an improved road will not be destructive. It is equally possible to design equipment which in its operation will make a fair road where none previously existed. The tractor-trailer system is coming to be of the greatest advantage to the contractor, and it would be unfortunate should any ill-advised installations bring it into disrepute.

POSSIBILITIES IN ELECTRIC TRUCKS

The electric storage battery truck has not as yet made great inroads into the contracting field. It is rightly regarded in its commercial aspects as a city truck, but much engineering construction work is carried on in cities, or in localities where the roads are improved. In much of this work electricity is used, and whether purchased from central station or generated in the contractor's plant its cost is probably lower than commercial consumers are obliged to pay. Since the electric truck has shown its decided advantages in so many business installations and has also, in the form of a tractor, operated efficiently in certain specific cases, this type of vehicle should not be arbitrarily ignored in considering an equipment, as an analysis of its possible advantages might prove surprising. The modern high-grade charging and interchangeable battery system has greatly reduced operating costs with



5—TRAILER TRAIN TRANSPORTING TWENTY TONS OF REINFORCED-CONCRETE PIPE

an increased ton-mileage capacity. Some tests were recently made with electric on a material haulage proposition involving loading from hoppers at tide-water and delivering by chutes at several distant points at higher elevations, thus requiring that the trucks should haul their maximum loads up grade, returning down grade empty. The estimated tonnage delivery cost worked out lower than present actual costs with horses and gasoline trucks. Where the cost of current is low the electric should be investigated, even though road surfaces and grades would at first sight seem to render it unsuitable.

GAS-ELECTRIC OUTFITS

A new application of an old system which it is believed can be applied extensively in engineering works is the gas-electric tractor and trailer. In this system a gasoline-engine and generator unit having a greater capacity than may be required for mere haulage purposes furnishes the power plant of the tractor, which is driven by electric motors through a simple standard electric control. The surplus electric power is available for the operation of auxiliary electric motor-driven devices for loading and handling material or other purposes, and these auxiliaries may be located at a dis-

tance from the tractor and trailers if desirable. The only prominent application of this system at present is in the "model district" of the New York Street Cleaning Department; but it offers a means for effecting great economies in first cost and operating expense in a contractor's plant.

TIME ELEMENT IMPORTANT

The time element, as well as the reliability of service in engineering operations, is usually of utmost importance; and the fact that the truck is so rapid, reliable and mobile renders it of particular value. As has been shown on the Mexican border, motor trucks of standard types can be readily equipped with detachable flanged tires and run on rails.

Trucks have also been used to haul trains of cars on industrial railways. Roads impassable to other traffic have been traversed by motor trucks by laying wheelways of plank, if for temporary use, or channels or I-beams laid flat on the road surface if for more extended use. As the contractor becomes more and more familiar with the capabilities of the numerous types of motor trucks available he will doubtless exercise his ingenuity by utilizing these units in many ways as yet unthought of, with a saving in time, cost and equipment.

Success in Earth-Road Contracting

Small Capital Encourages Incompetents to Bid—Experience and Good Equipment Necessary If Work Is to Be Done Well and at a Profit

By W. S. KELLER

State Highway Engineer of Alabama

NO FORM of road construction requires as little equipment, and consequently as little capital, as do those roads which are simply graded or surfaced with sand clay or top soil. Ten teams, necessary wagons, wheel and drag scrapes, plow, road machine and harrow, with small tools and camp equipment, are about all that is necessary for a man to have to enable him successfully to carry to completion a contract for such a road. The consequence of this is that there are far more contractors in the South bidding on sand clay, top soil and earth roads than those bidding on macadam or other hard surfaced roads requiring an outlay of expensive machinery. Incidentally, this is one of several reasons why such roads can be built at such a low cost.

Moreover, this fact of low cost of equipment is responsible for a large number of novices going into the contracting business, and coupled with the consequent competition, the failure of many.

"MAKING A SILK PURSE OUT OF A SOW'S EAR"

The engineer in charge of such road construction has many problems, the most difficult of which is making a "silk purse out of a sow's ear," or a finished contractor out of a green farmer. Unfortunately very few board of county commissioners have backbone enough to throw out the lowest bidder, provided such bidder can make bond. The law generally says the contract shall be let, if at all, to the lowest responsible bidder. County commissioners reason that any man who can make bond is

thereby responsible, otherwise he could not get a surety. The experience of the writer has been that almost any man can make bond, regardless of his financial or moral responsibility.

An illustration of this point: Bids were opened in an Alabama County for the construction of 6 miles of top-soil road. Two bids were by farmers who had never done any kind of road work. Both of them bid absurdly low. On plain and reinforced concrete, the lowest bids were \$1.50 and \$1.75 per cubic yard respectively. Both bidders were far below cost on other items. The court objected strenuously when the assistant state highway engineer refused to consider these bids, and argued that if the low man could make bond, the contract should be awarded to him. Although the third man's bid was very reasonable and he was a responsible, experienced contractor, it was thrown out because of the two worthless bids below his, and new bids were called for. The sequel—one of the two men who were low the first time, again was low, at better but still low prices. He was awarded the contract, and much to the surprise of everyone made bond with a reputable bond company. Needless to add, the engineer had his hands full in seeing that the specifications were complied with.

It is difficult to convince the average county board that a reputation for good and honest work is a great asset and should be taken into consideration. It would be difficult to value a good reputation in dollars and

cents, but it is not difficult to measure the value of a contract with a reputable contractor in comparison with a contract made with a contractor without reputation.

The inclination of the public to criticise a board for not awarding a contract to the lowest bidder is, of course, the chief cause of this trouble. The public knows nothing of the relative value of bids and draws no distinction between contractors. A bond and the engineer are the twin reasons offered as an excuse for awarding a contract to an incompetent man or firm. No contractor who is well equipped and bears a reputation for doing honest and efficient work should be barred from bidding on work, but on the other hand it is far better to place the stamp of disapproval on a man before his bid is offered than to take a chance on his not being the low bidder.

RELIANCE ON CONTRACTOR

In the construction of sand-clay and top-soil roads a contractor experienced in such work is of great value to the engineer. By the proper handling and distribution of earth in grading, material that is genuine sand-clay or top-soil can be left on the surface for a final wearing surface. An engineer cannot be constantly present to direct such work and of necessity must depend to a certain extent on the good judgment of the contractor.

A large percentage of stations on a sand-clay road are generally finished when grading is finished, for the reason that the hills usually contain sand-clay naturally mixed, so that when graded down the road in the cuts and for some distance out on the fills both ways are of the proper mixture. This necessitates care upon the part of the contractor to the end that the finished grade has the proper cross-section and a uniform smooth surface. It frequently happens that after passing over a sand-clay hill the road for a mile or more is through deep sand or a sticky clay not suitable for road building. The cutting of this hill below the soil line is left until the sand part is ready for surfacing. The material from the cut being used for surfacing, the contractor is paid for the work at his surfacing price.

In this work the importance of the contractor's having a good knowledge of the road-building qualities of sand

clay and top soil and of being able to tell good from bad on sight cannot be overestimated. He can make money for himself and save a great deal for the county. He soon becomes convinced of the importance of machining his road daily after exercising great care in the spreading of material.

When mixing sand with clay is required, the good judgment of the foreman in charge is worth a great deal. Nothing is better to compare it with than the skill of mixing flour to make bread. A novice might follow the recipe to the letter and make a failure where the cook with good judgment and skill never fails. As a little too much flour will spoil the bread, a little too much sand will spoil the road. No specifications, it matters not how carefully written, can cover the constant change of soils, except in a general way, and the co-operation of the contractor is therefore very valuable. We in Alabama who have charge of road work endeavor to make the contractor feel that the road is his and that he should take a pride in it. To this end, he is given full credit for his good work by appreciative comment, and by praise through the local paper when opportunity presents itself. Nothing discourages a man more than to have someone else receive the credit to which he himself is entitled.

EQUIPMENT

The most successful contractors confining their work almost exclusively to sand clay and top soil roads have been those who have been equipped with good teams and up-to-date machinery, and who have so systematized their work that when a monthly estimate is received they can tell at a glance what unit of the work was done at a loss and where a profit was made. A number of small contractors a few years ago, bidding only on jobs with total expenditures of from \$5,000 to \$15,000, by close attention to work have succeeded to the extent that they do not hesitate to bid in work involving an expenditure of \$100,000 or more. Without a doubt the most successful contractors are those who give careful consideration to their outfit. The man who starves his live stock, neglects his machinery and cheats his labor is doomed to failure.

Influence of Federal-Aid Road Law on Highway Development

Measure Gives First Importance to Maintenance, Will Set Better Road Standards in All States and Bring About Uniform Accounting System

By A. B. FLETCHER

Highway Engineer, State of California

AT LAST, after many years of argument, the United States Government has entered into active participation in the improvement of highways. The writer for nearly 25 years has listened sceptically to the prophecies made at each session of Congress that a national road bill would be forthcoming.

The restrictions under which the funds are to be expended insure to the people of the country indirect returns of very great value, in addition, of course, to a

large additional mileage of improved road, made possible by the funds appropriated by the act. These indirect returns are found in the influence which the measure will have on all the highway work of the nation, even on that which does not get federal aid. It will put maintenance in a new light, particularly before laymen highway officials. It will set higher road standards for every section of the country. It will bring about a uniform system of road accounting.

Before discussing these influences of federal aid it will be well to review briefly the outstanding features of the present law.

In the strictest usage of the term, the national road has not arrived yet, but the Bankhead Bill signed by President Wilson last July is a near approach to such legislation. This law, known as the Federal Aid Road Act, is a compromise measure, but, unlike most compromises, it seems likely to be most effective and to answer most of the requirements.

Two factions have for years been importuning Congress to appropriate government money for road purposes. One party, representing perhaps chiefly the agricultural interests of the Middle West and the South, has desired an appropriation to be assigned in relatively small allotments to all of the counties of the United States, the money to be used by these counties substantially at their discretion and with little or no control by the Federal Government. This plan of course smelled loudly of the "pork barrel," but it had many advocates. Another party, with which the motor-vehicle enthusiasts allied themselves, urged a policy almost diametrically opposed. They desired a system of national roads built and maintained by the government, as are the *Routes Nationales* of France, and to extend from the Atlantic Ocean to the Pacific and from Canada to Mexico.

Neither scheme prevailed, but the law which passed approaches more nearly the national road idea and indeed, in the future, a national highway system may develop from the Federal Aid Road Act.

MAIN FEATURES

Secretary Houston of the Department of Agriculture, in his article in the *American Review of Reviews* last September, explained some of the features of the new law in the following language:

"It authorizes the Secretary of Agriculture to co-operate with the states through their respective state highway departments in the construction of rural post roads. This principle is important and significant. Heretofore the agencies of the state and the federal governments have too often usually proceeded entirely independently and not infrequently worked at cross purposes and sometimes in an antagonistic spirit. The principle of co-operation between the two governments is extending and promises much for the people whom they serve.

"Federal money may be expended only for the construction of post roads. The term 'construction' is interpreted to include reconstruction and improvement, the latter excluding merely the making of needed repairs and the preservation of a reasonably smooth surface. To maintain the roads constructed under the provisions of the act is made the duty of the states or of their civil subdivisions according to the laws of the several states, and it is provided that, if the Secretary of Agriculture shall find any road in any state so constructed is not being properly maintained within a given period, he shall give notice of this fact to the highway department and, if within four months from the receipt of the notice the road has not been put in the proper condition of maintenance, no further aid can be extended to such state or civil subdivision.

"Perhaps the weakest point in good roads legislation

and practice has been the lack of adequate provision for maintenance. It will be essential under the terms of this act that, in considering proposed road projects, careful regard shall be given to the provisions to be made by the states or their civil subdivisions for the maintenance of roads in the discharge of this duty. The construction work in each state must be done in accordance with the laws of the state and under the direct supervision of the state highway department, but the Secretary of Agriculture is given power to inspect the work as it proceeds, to approve it, and to make the necessary rules and regulations for the enforcement of the act. It is stipulated that the projects shall be substantiated in character and that expenditure of federal funds shall be applied only to such projects.

"In accepting the terms of the act the state, as a matter of course, pledges its faith to the five-year program. This is important because it makes possible the arrangement of a comprehensive scheme of road building. Obviously the expenditure of the entire amount of money contemplated under the act should be planned at the outset as far as possible and road systems and projects conceived accordingly. This does not bind the state legislature to make an appropriation at the first session for the five-year period. This would be prevented by the constitution of many states; but it does involve a pledge of the state's faith to continue the appropriations according to the terms of the act; and even where the counties contribute the necessary funds, the assent of the state must be had and the other terms of the act, such as the existence of a highway commission and the acceptance of the duty of maintaining roads, must be complied with.

"The contribution of the Federal Government for the construction of any road is limited to 50 per cent of the estimated cost of it and cannot exceed 50 per cent of the actual cost.

DEALS WITH HIGHWAY DEPARTMENTS

"The state is the lowest unit with which the federal government may co-operate, and only through a state highway department. This is made especially clear by the requirement that the Secretary of Agriculture and the state highway department of each state shall agree upon the roads to be constructed therein and the character and method of construction, and that any state desiring to avail itself of the benefits of the act shall by its state highway department submit to the Secretary of Agriculture project statements setting forth proposed road construction. If the secretary approve such project the highway department shall furnish to him such surveys, plans, specifications, and estimates therefor as he may require.

"It will be especially noted that there must be an agreement between the Secretary of Agriculture and the state highway department of each state on the roads to be constructed, that projects, plans, specifications, and estimates shall be submitted by the state highway departments and approved by the Secretary of Agriculture before any federal money can be expended.

"The initiative under the act lies with the states, and the federal government cannot begin operations until after the acceptance of the act by the state, a state highway department has been created, if none exists, and road projects and the requisite engineering data have

been submitted to the Secretary of Agriculture and approved.

"This Federal Aid Road Act was designed not only to promote road-building, but also adequately to safeguard through efficient machinery the expenditure of all funds arising under it. There is good reason for believing that these purposes will be realized. It is highly probable that it will do much more than this. As has been pointed out, the nation is now annually spending the equivalent of \$225,000,000 for road-building. The improvements of administrative agencies and methods which will certainly follow the operation of this act should lead to greatly increased efficiency in the expenditure of these large additional sums. In such case, the nation will realize great benefit not only from the expenditure of the joint funds but also of the separate surplus money of the states and communities."

NO PORK BARREL

There is little chance of politics in the plan as Secretary Houston explains it and the writer is unable to see in the law any "pork barrel" possibilities.

By the secretary's insistency upon a five years' plan of operation, vouched for by state authorities as a condition precedent to his approval of any project for federal aid, it is assured that the government money will not be spent in haphazard fashion nor piecemeal on short roads not connected with a comprehensive highway system.

The act seems to emphasize somewhat unduly in the opinion of many state highway officials the post-road feature. A too rigid construction of the wording of the law would limit the use of the government appropriation to work on rural post roads and bar out some vastly more important trunk lines over which, from force of circumstance, the United States mails are now carried, but it is believed that the Department of Agriculture will construe somewhat liberally the provision of the act that the term "rural post road" means "any public road over which the United States mails now are or *may hereafter be transported*" by placing considerable emphasis on the words "or may hereafter be." But little imagination is needed to foresee that the mails must shortly be carried over nearly every main road important enough to be considered by a state as a part of its state highway system.

The real work of administering the activities under the Federal Aid Road Act will fall upon the Office of Public Roads and Rural Engineering of the Department of Agriculture. This subdivision of the department under Logan Waller Page, its director, has been in existence for many years. Its activities heretofore have been limited chiefly to research work, the giving of advice to highway officials, the publication of bulletins concerning road economics and the construction of a relatively small mileage of experimental highways. All of these activities have been useful and necessary and ably administered, but hereafter the Office of Public Roads will be engaged mostly in a far more valuable character of work in so far as the betterment of the highways of the country is concerned.

Under the present law the office will be concerned with the expenditure of not less than \$170,000,000, including the combined federal and state appropriations and the roads in the National Forests. This means

that the office will examine and criticize the plans and specifications for probably more than 20,000 miles of rural highways, and it has an opportunity, such as has never before been possible, to exemplify and to enforce the best practice in highway engineering in all of the states of the Union. All of the highway work done with this huge sum will be under the inspection of the engineers of the government. No inferior work will be tolerated, and if such work is attempted the government payments will cease. With the government funds at its disposal the Office of Public Roads has the whip, but it is almost unthinkable that the whip will ever have to be used.

STANDARD TYPES OF ROADS

The writer does not believe much in the so-called standard types of road for use everywhere, believing that it is obvious that the particular needs of each locality should be studied, but the federal engineers will doubtless standardize the different types of pavement and their advice will be invaluable because of the great extent of their field of operation.

In the matter of new surveys and plans the government engineers will set up standards of excellence which the states will doubtless gladly conform to. These standards will be of great assistance in some of the states where the state highway departments are none too strong. Often the highway engineer has had difficulty in convincing the members of the legislature of his state that accurate surveys and plans are needed and he has had to work with insufficient appropriations for engineering expenses, but if he can point to the government requirements for these features, he will need no further evidence.

The government requirement that cost data be kept upon demand on the federal-aid projects will produce a mass of information of great value to the highway officials of the country. Final reports of each project on forms prescribed by the government showing the work done and its cost analyzed will be required. Comparisons may thus be made easily, not only of the cost of projects within the boundaries of a single state, but also between the costs of work in the different states. Such comparisons will be extremely useful.

In the single matter of "overhead" expenses, if they are reported on the standard forms prescribed by the Office of Public Roads, it will no longer be possible for a state to report its "overhead" on its state highway construction at 3 per cent and make anybody believe that it has included all of the items which should have been charged to that account.

PROPER MAINTENANCE THE CHIEF BENEFIT

But perhaps the chief benefit to accrue from the federal aid law lies in its provision for the proper maintenance of the highways after they are built. No project for federal aid will be approved by the Secretary of Agriculture until a showing is made that funds are available or will be made available for the maintenance of the work to be done under the project agreement. Further, as Secretary Houston has stated, the law provides that if the road is not put into proper condition within four months from the receipt of a notice from the secretary, no further road project from the state concerned will be approved.

Arch Design Adopted for Galveston Causeway Reconstruction

Reinforced-Concrete Arch Plan and Continuous-Girder Plan Compared—Reasons for Changes Recommended by Arbitration Board

AFTER the hurricane and storm of Aug. 16 and 17, 1915, washed out the 5900 ft. of paved sand-fill approaches of the Galveston causeway, leaving intact, however, in the middle of the bridge the twenty-eight 70-ft. main arch spans of reinforced concrete, plans were made for new approaches. After more than a year of delay and differences between the five interests concerned in the reconstruction, the arbitration board appointed to decide whether the early proposal for arch spans or a later alternate design of continuous curved reinforced-concrete girders should be adopted has reported in favor of the arch type, as noted in the news section of the issue of Dec. 16. This design, by the terms of the arbitration agreement, has been adopted by the board of engineers. The finding showed the arch design to be \$141,000 less in estimated cost than the curved-girder design, allowing for the recommended changes.

An account of the storm damages, together with a drawing showing the details of the 70-ft. existing arch spans and the old approaches, will be found in the issue of Aug. 28, 1915, page 271. The present article will consider the details of the adopted 60-ft. arch spans, of the alternate 30-ft. girder spans, the recommended changes made by the Board of Arbitration and the reasons for them.

INTERESTS CONCERNED

The Galveston causeway is to be used by five different interests, each interest having one representative on the Board of Engineers which was given authority to act upon the details of the reconstruction. The three railroad interests are the Gulf, Colorado & Santa Fé Railway, represented by F. Merritt, chief engineer, selected

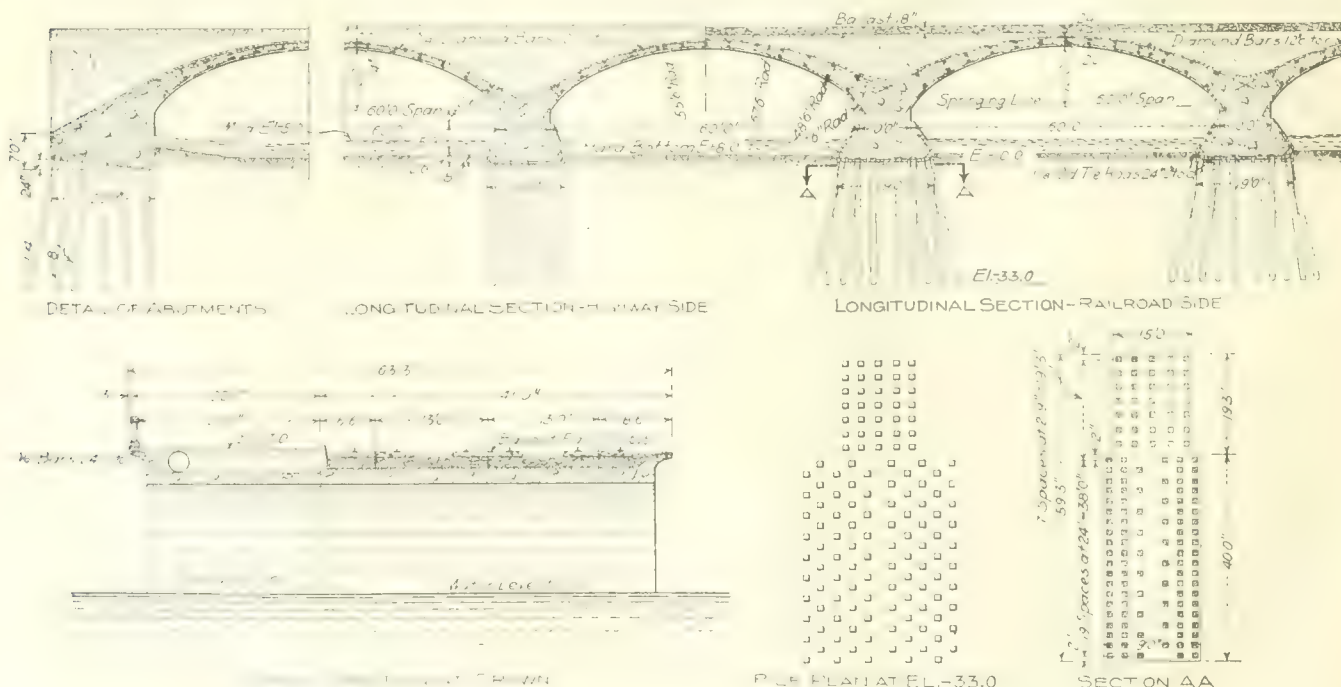
as chairman of the board; the Southern Pacific Railway (Sunset Central Lines), represented by I. A. Cottingham, engineer, and the Galveston, Houston & Henderson Railroad, represented by J. H. Hill, vice-president and general manager. Galveston County is represented on the board by the county engineer, R. M. Sias, and the Galveston-Houston Electric Railway Company is represented by Mark Lowd, Southwestern manager, Stone & Webster Engineering Corporation.

DESIGNS CONSIDERED

After consideration by this board of an arch design, there developed on the part of the railroad interests during negotiations seeking to fix the proportionate share of each interest in the cost of the reconstruction a desire to obtain alternate plans. Several such designs were therefore obtained. The reinforced-concrete curved-girder type submitted by J. L. Harrington, of Harrington, Howard & Ash, consulting engineers, Kansas City, Mo., was favored by the railroad interests, while the reinforced-concrete arch plan submitted by William Mueser, of the Concrete Steel Engineering Company, New York City, who designed the present 70-ft. arches, was favored by the county and the interurban railway.

A board of arbitration was then constituted to consist of one representative for the railroads, who selected Prof. A. N. Talbot of the University of Illinois, one for the other two interests, who selected Prof. George F. Swain of Harvard University and the Massachusetts Institute of Technology, and a third member selected by the other two to act as chairman—Lincoln Bush, consulting engineer, of New York City. After careful investigations and hearings in Galveston covering three days, the board on Dec. 4 unanimously recommended the arch plan. Through the courtesy of Mr. Merritt, chairman of the board of engineers, the alternate plans and recommended changes are here presented.

The arch design is very similar in outline to the existing 70-ft. arches; in fact, the first proposal was to use



DETAILS OF THE 60-FOOT ARCH DESIGN WHICH WAS RECOMMENDED BY THE BOARD

70-ft. arches on each side of the existing spans and 50-ft. spans between the uninjured sheet piling. When the desire for greater low-water areaway became apparent and the removal of the piling was proposed, a new design for 60-ft. arches, as shown in one of the drawings, was developed. This was economical because it lowers the springing line and therefore reduces the unbalanced thrust on piers, and because in the construction of these piers the relative cost is less in proportion to the cost of piers for the 70-ft. arches in deeper water. More piers and shorter arch spans thus became the proper solution for greater economy.

Another element of economy is in the use of the old $1\frac{1}{8}$ -in. tie rods (with turn-buckles) spaced on 9-ft. centers connecting the two rows of sheet piles driven for the original structure. These rods are specified for the reinforcement of the new piers, and it is proposed to clean and cut them to length by oxyacetylene flame. Thus the cost per ton for reinforcement is reduced from about \$80 to \$30. Reinforced-concrete piles 25 ft. long, 13 in. square at the top, 11 in. square at the lower end with 4-in. taper to a point 7 in. square are proposed for the foundations. The arbitration board, however, strongly recommends the consideration of creosoted timber piles. The present piers are founded on timber piles, but some question arose as to the danger from teredo, and the concrete pile design was made.

After construction, the present concrete sheet piling is to be drawn or broken off at the bed of the bay, and thus a maximum of unobstructed waterway will be furnished. There will be fifty-two 60-ft. clear arch spans in the 3650 ft. of the approach on the Virginia Point side, and thirty-two spans in the 2250 ft. of the approach on the Galveston side.

30-FOOT REINFORCED-CONCRETE GIRDER DESIGN

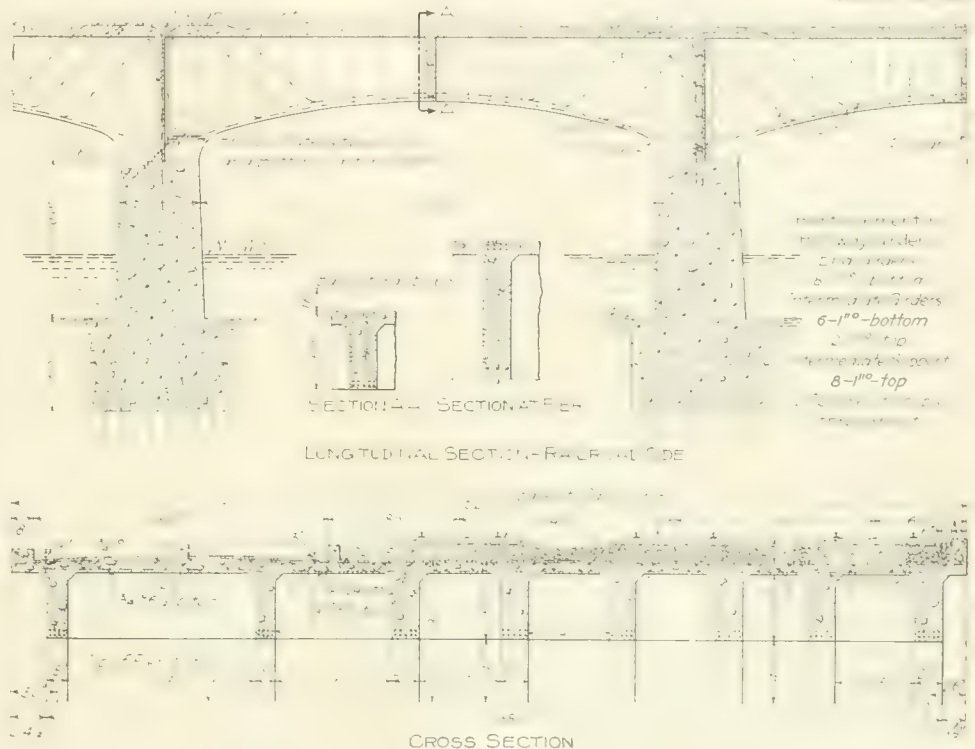
As shown by the drawing of the details of the continuous girders, two sizes of curved girder, one for the highway part and one for the railway part, were designed. For the roadway portion of the structure a live load of 150 lb. per square foot in conjunction with either 12-ton motor trucks or a 15-ton road roller was assumed, with 25 per cent impact for the concentrated loadings. For the railroad girders Cooper's E-50 loading, with 40 per cent impact, was used, assuming each axle load distributed over 13 ft. transversely. As expansion joints occur at every third pier, the structure is continuous over three 35-ft. spans between centers of piers, or a length of 105 ft.

The piers were detailed as shown, 5 ft. wide at the top, tapering slightly to the spread base. Piles in three

rows, fifteen in each row, are shown. At the piers where expansion joints are provided copper-plated cast-iron plates are shown, with a curved surface specified for the upper plate and a bronze bearing plate between.

RECOMMENDED CHANGES—ARCH PLAN

As a result of independent exhaustive analysis of the arch design, the board of arbitration made four specific recommendations: (1) The addition of $\frac{7}{8}$ -in. square longitudinal bars 14 ft. long on 12-in. centers between



DETAILS OF THE ALTERNATE CURVED GIRDER DESIGN WHICH WAS CONSIDERED BY THE BOARD

the reinforcement shown on the plan in the extrados at the ends of the arches under the railroad and interurban tracks, starting at the centers of piers; (2) the addition of $\frac{1}{2}$ -in. longitudinal square bars 14 ft. long on 12-in. centers between the bars in the intrados at the crown under the railroad and interurban tracks; (3) the widening of the concrete pier bases 2 ft. on each side only for $2\frac{1}{2}$ ft. depth; (4) the use of a richer mix for the piers, abutments, spandrel walls, and end retaining walls, making this concrete 1:8 instead of 1:9 for ratio of cement to aggregates.

The reasons for these changes are as follows: (1) The computations for maximum stress at the ends of the arch showed a possible tension of 124 lb. per square inch in the concrete (equivalent to about 1860 lb. in the steel) when a temperature variation of ± 15 deg. was considered with live loading simultaneously on all tracks. To prevent any possibility of cracking the concrete under a greater temperature range, the additional steel was prescribed. (2) To provide for possible impact effects from live loading near the crown where the depth of fill is 6 in. out to a depth of fill of about 3 ft., additional steel was specified. (3) To allow somewhat better arrangement of piles and to provide a wider margin for inaccuracies in driving and at the same time facilitate construction by widening the pier bases to the lines of

foundation sheeting, if used. (4) To better prevent possible action of sea water a richer and denser concrete was specified.

RECOMMENDED CHANGES—30-FOOT GIRDER PLAN

The changes recommended by the board of arbitration and upon which the final estimate of cost was based include a considerable addition to the number of piles, changing the transverse diaphragms from 8 in. to 12 in. thickness, lengthening the piers, and the addition of steel in the bottom of the girders in the end spans.

The reasons for these recommendations are generally clear by inspection of the drawing. The greater number of piles would be required to carry the loading; the piers are not reinforced and are too short, being flush with the outside girders, inducing shear in the concrete from loads on these girders; the thickness of diaphragms was considered insufficient for lateral stability and to resist thrust from storm-driven wreckage or vessels, the longitudinal steel in the end spans for resisting positive bending moment was considered insufficient.

The design of the arch ring by the Concrete Steel Engineering Company was made by assuming the concentrated loads of one engine of Cooper's E-50 loading to be distributed uniformly over 13 x 56 ft., giving 487 lb. per square foot for all three tracks, with 50 per cent impact at the crown varying uniformly to 0 per cent at 25 ft. from the crown on each side, or 2 per cent decrease per foot.

In the analysis by the chairman of the arbitration board the arch ring was divided into twenty equal divisions, and the stresses in the top and bottom of each due to a single load at the center of each division were computed. Maximum and minimum stresses could then be obtained by loading the proper sections, assuming the concentrated loads distributed transversely over 13-ft. width. A temperature variation of ± 15 deg., based upon government records for mean monthly averages from 1871 to 1915 inclusive, showing a variation of 30 deg., was taken. Each member of the arbitration board made independent determinations of the stresses.

RELATIVE COST OF THE TWO PLANS

The relative costs of the two alternate designs, as estimated by the board of arbitration, are \$1,344,000 for the arch plan as submitted and \$1,431,000 for the girder plan, not including the cost of repairs on the Galveston approach. The recommended changes were estimated at \$32,300 total for the arch plan and \$86,000 total for the girder plan, so that final relative costs would be \$1,376,300 and \$1,517,000, a showing of \$141,000 in favor of the arch.

The total cost, including repairs to the 2300 ft. of the Galveston approach, should fall within the \$1,500,000 agreed upon by the board of engineers, as reported by the arbitrators. This total cost is to be divided among the five interests as follows: Forty-five per cent to the three railroads, 33 per cent to Galveston County and 22 per cent to the interurban railway. The board of engineers on Dec. 12 passed a resolution authorizing Mr. Mueser to draw up complete detail plans and specifications in accordance with the recommendations of the arbitrators, to include alternate plans for creosoted pile foundations, these plans and specifications to be approved by the board of arbitration.

Water Hammer Cracks Shell of Four Inch Centrifugal Pump

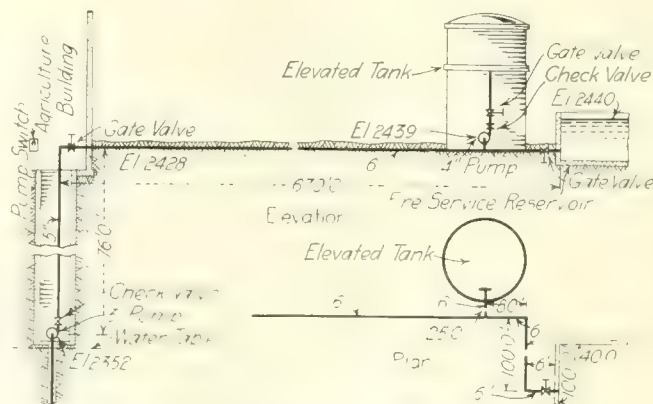
Flow to Fire-Service Reservoir Suddenly Stopped by Opening Switch on Power Line, Causing Impact of Water Columns in Pipe

By A. L. ENGER
Tucson, Arizona

WATER HAMMER, resulting from a sudden shutting off of power from a well pump at the University of Arizona, broke the shell of another centrifugal pump employed as a booster to supply an elevated tank. To prevent the recurrence of such an accident a check valve has been placed in the pipe line near the fire-service reservoir into which the well pump discharged.

The sketch shows the system of piping from the well to the elevated tank and the new fire-service reservoir. The two pumps shown are single-stage centrifugal pumps direct-connected to induction motors.

The pump in the well has a 3-in. discharge and furnishes 415 gal. per minute when pumping into the fire-service reservoir. The pump under the tank is a 4-in. pump and is used for boosting the water from the 3-in. pump into the elevated tank. Ordinarily, the 3-in.



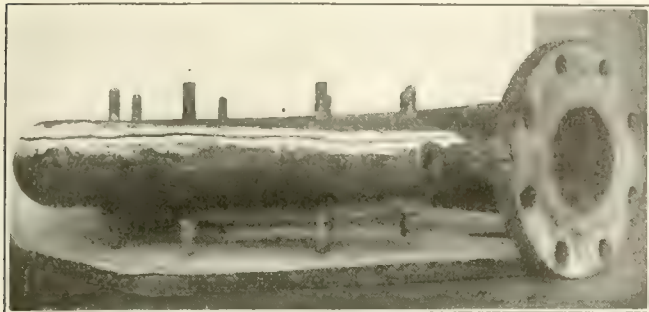
ARRANGEMENT OF PIPING, RESERVOIR AND PUMPS AT UNIVERSITY OF ARIZONA GROUNDS

centrifugal pump discharges into the fire-service reservoir, from which the water overflows into the irrigation system watering the campus.

WATER HAMMER WHEN PUMP STOPPED

When the well pump was first installed, the violent water hammer caused by suddenly stopping the pump when discharging its normal capacity was observed, and a rule was therefore made that the gate valve in the discharge line at the top of the well should be closed—stopping the flow from the pump—before the pump was stopped. One day, through a misunderstanding, the main switch on the power line to the campus was pulled out while the well pump was discharging into the fire-service reservoir, and the resulting water hammer broke the case of the 4-in. pump under the elevated tank. The crack shown in the photograph is on the suction side of the case and extended about three-fourths of the way around the pump. The gate valve just over the 4-in. pump was closed at the time of the accident.

One explanation of this accident is as follows: It



HOW WATER HAMMER CRACKED CASING OF CENTRIFUGAL PUMP

is assumed that the water in the vertical section of the discharge pipe in the well stopped rising almost immediately after the power was shut off, and settled down on the check valve. The water in the horizontal pipe, flowing with a velocity of about 4.7 ft. per second at the instant the power was shut off, would not stop immediately, but would continue forward for a short time, due to its inertia, causing the column of water to separate near the top of the well. The pressure of the water in the reservoir then forced the water in the horizontal pipe back, and at the impact between the two columns of water a pressure wave was generated which traveled through the pipe line and broke the case of the 4-in. pump.

Blind Drains Cure Chronic Mudholes

Wet, soft spots in earth roads which easily become chronic mudholes are easily mended, says H. G. Shirley, chief highway engineer of Maryland, in *Illinois Highways*, by digging out the soft material and filling in layers of field stone. Three logs then make a blind drain and more stone and earth are placed on top.

No Rust in Galvanized Steel Tower at Iloilo After 12 Years

Unusually Severe Climatic Conditions Do Not Affect Coated Material—Economical Because No Maintenance Cost

By J. L. HARRISON

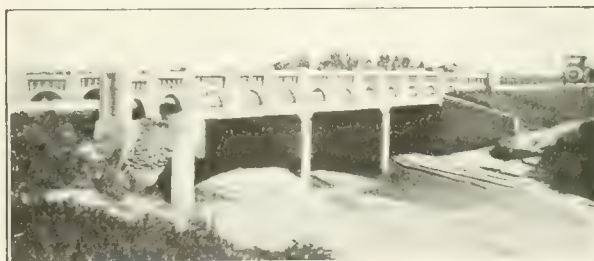
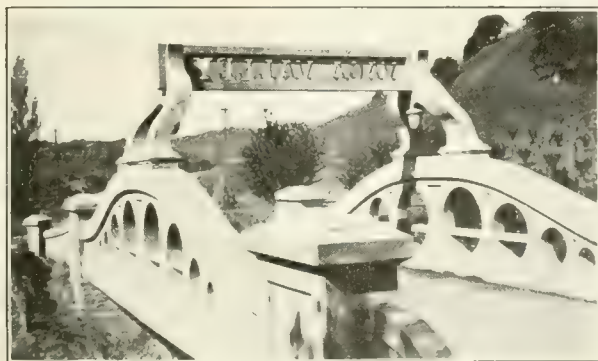
District Engineer, Bureau of Public Works, Manila, P. I.

THE PRACTICE of protecting steel by covering it with coatings of various kinds of paint is so universal, especially as applied to framed structures, that any other method is conspicuous. Therefore the steel signal tower at Iloilo, in the Philippine Islands, a 100-ft. tower built for the purpose of making possible the observation of steamers approaching this port, is of unusual interest because it is an illustration of the success which may be obtained in preserving structural steel by galvanizing it.

In 1904 the customs authorities asked for bids on a signal tower which would be of sufficient strength to carry certain lights and signals and house the observer, whose duty it was to give notice of approaching vessels. They had decided that a wooden tower would cost less than a steel tower and would require much less maintenance because of the well-known fact that the sea breezes at Iloilo carry so much salt spray that steel structures have to be constantly painted and repainted; hence the average annual cost of a wooden tower would be considerably less than the average annual cost of a steel tower.

Believing this to be an illogical conclusion, a local firm of British engineers, Strachan & MacMurray, entered a bid on a steel tower and offered to design and erect a satisfactory tower for a price only slightly in advance

These Four Types of Rails for Concrete Highway Bridges Are Found in Solano County, California



of the price asked for a wooden tower. All members were to be galvanized after they had been cut and punched, and galvanized bolts, instead of rivets, were to be used throughout. After a careful consideration of the offer, the customs authorities accepted it and the tower was erected.

UNUSUAL CONDITIONS

The locality in which this tower was erected is unusual. Due to the salt breezes which prevail, and to the uniform high temperature, corrosion of iron or steel is very rapid. In fact, $\frac{1}{8}$ in. of scale has been removed from reinforcing bars which had been left exposed near this tower for less than a year. Paint applied in three coats has to be renewed in from one to two years. Notwithstanding these severe conditions, this galvanized steel tower apparently has not a spot of rust on it. It has withstood the extraordinary deteriorating influences so well that the original shop marks on many of the members can still be read. In fact, to-day it is in practically the same state that it was at the time of its erection twelve years ago. Moreover, having served its usefulness in Iloilo, it is considered valuable enough to be taken down and re-erected at another port.

As far as can be learned, the maintenance cost on the tower has been absolutely nothing. It has never been painted, nor has any other work ever been done on it since erection. The query whether this method of preserving steel could not be more frequently adopted with economy naturally arises. Of course, just at present the price of spelter is abnormal, but under ordinary conditions there can be little doubt that the added cost of galvanizing steel would in many instances be much less than the cost of constant painting and repainting.

Probably the use of galvanized members would not often be economical in the northern part of the United States or in the arid regions of the West, but in the damper regions and in all coastal locations the capitalized cost of the constant maintenance which steel structures require would often considerably exceed the additional first cost of galvanizing all exposed members. In the tropics the cost of maintenance will almost always exceed the cost of galvanizing.



NOT A SPOT OF RUST AFTER
12 YEARS OF SERVICE

Will Publish Alaska Railroad Paper

The Alaskan Engineering Commission has established a weekly eight-page publication devoted to railroad construction work in Alaska for the dissemination of information of general interest to the thousands of employees of the various divisions of the government forces. The name of the new paper is the *Alaska Railroad Record*.

Letters to the Editor

*Comment on matters of interest to engineers
and contractors will be welcomed*

Is Uniformity Possible in State Motor-Truck Legislation?

SIR: The editorial in the Engineering Record of Dec. 9, page 699, aptly sets forth the advantages of uniformity in state motor-truck legislation, and we feel that there is little of value that we can add.

Notwithstanding the desirability of uniform laws, there are some practical difficulties which may, to a certain extent, prevent the accomplishment of the desired end. For example, the Legislature of Michigan convenes Jan. 1, 1917. There is much sentiment in favor of passing laws which will limit the use of traction engines and motor trucks at the coming session. If the matter is not considered this year, the opportunity will be lost for two years, during which time much damage may be done.

Doubtless in other states also immediate action is necessary in order to present laws to the legislatures, thus precluding any general conference. Fortunately there is already some desire on the part of several states to correlate their legislation. Also there are almost certain to be minor modifications necessary in different states.

We should like to take this opportunity to qualify a statement made in our previous letter bearing on the subject of regulatory measures which appeared in the Engineering Record of Dec. 16. With reference to the use of steel tires on trailers we stated that their use would not be relatively more destructive to the pavement than similar tires on horse-drawn vehicles. This is, of course, true only when the truck and trailer are traveling at about the same rate of speed as horse-drawn traffic and with reasonable limitations as to loads.

FRANK F. ROGERS,
State Highway Commissioner of Michigan.
Lansing.

SIR: I believe you are right in the suggestion that the engineer, rather than the lawyer, ought to take up and solve the problem of the regulation of traffic to conserve highways. I have noticed with considerable interest your editorial of Oct. 28 on this subject, with comments in the issue of Dec. 16, and I am glad to find the engineering press placing the fact and experience of the engineers before the public so that our legislators may legislate with the fullest light possible.

At the September session of our Board of Supervisors one angle of this question was brought forward by the writer, and the board, by unanimous action, requested our local representatives in the General Assembly to take up the matter of the regulation of the use of tractors on our new public highways, particularly those tractor owners who persist in using lugs on the wheel rims.

Motor-truck traffic as at present developed in this community, ordinarily using rubber-tired rims, holds

no terror for us when building rigid types of road. I feel that every style of vehicle ought to be regulated and limited to certain weights on wheel, width and length of vehicle, maximum load, etc., so that we may in the future be able to design a roadway satisfactory for the vehicle, for it is much easier to design the motor for the road than the road for the motor. The road of first-class type when constructed must necessarily last for a long time to give a return on the money expended. Motor trucks last a relatively short time, but succeeding manufacturers cannot be guided in the design when each manufacturer tries to outstrip his rival in the size and capacity of his motor; hence the necessity for state regulation.

It is the weakness of democracy, however, that no two states regulate exactly alike, and now that the motor truck has made the haul interstate, state legislation ought to be uniform, both for the use of the designers of trucks and of highways. I have no doubt that the Illinois General Assembly will legislate in some manner on this subject at the coming session of the legislature, and it is essential that the proper information be placed before the legislators so that the legislation may be wisely enacted.

P. C. MCARDLE,

Vermilion County, Superintending Engineer.
Danville, Ill.

SIR: I read the editorial in the Engineering Record of Dec. 9, page 699, on uniform legislation throughout the different states for the control of motor-truck traffic on highways, with a great deal of interest. We have been giving this question considerable study, as we deem it one of the most important problems to deal with in road construction and maintenance. The development of motor-truck traffic has been rapid in the last few years, and, in my opinion, is just starting. Its possibilities are great. It is, therefore, an important problem and one which should be thoroughly studied before stringent rules or regulations are applied which will curtail its usefulness. I am heartily in sympathy with a co-operative movement among states to secure a uniform law, as near as possible, to meet local conditions which would govern the use of motor trucks on public highways.

The load per inch width of tire, speed, height of wheel and the width of motor vehicle should all be carefully gone into, and a standard reached, as nearly as possible. I do not see why it is not possible to specify the width of vehicle, the height of wheel, speed and load per inch width of tire, leaving the load that can be carried, including the weight of the motor vehicle, to be determined by seasonal conditions.

From a most careful study of the damage done by the use of such vehicles on certain types of roads, it has been my experience that the greatest damage is done in the spring of the year, when the frost is leaving the ground and the shoulders and sub-base are in the least stable condition to sustain the loads which are carried by trucks. We have found that during the summer months, when the sub-base is hard and the shoulders are firm and compact, the heavily loaded truck does not do a great deal of damage by breaking down the foundations or pushing out the edges of the macadam.

It is my opinion that to secure a maximum use of the truck and at the same time to do a minimum amount

of damage to the road surfacing, laws should be enacted governing the load of the truck very materially in such a manner as properly to protect the roads at the critical seasons of the year. In other words, there should be a maximum load prescribed in those states where the climatic conditions are such that there is a great deal of freezing and thawing, and softening up of the sub-base during the months of February, March and April. In other sections, where the climatic conditions do not affect the sub-base to such an extent, the seasons could be specified accordingly. By this method I believe the road surfacing would be preserved and yet give to trucks the maximum carrying capacity which roads are capable of sustaining at all seasons of the year.

I believe that 650 lb. per inch width of tire is all that we can expect the roads heretofore constructed to withstand, and that it is very essential that the many millions of dollars which have heretofore been expended by the states and counties in constructing types of roads which were not designed to carry such traffic should be protected by putting certain restrictions on the loading capacity, speed and width of tires of motor vehicles.

H. G. SHIRLEY,

Chief Engineer, State Roads Commission of Maryland.
Baltimore.

SIR: I strongly believe that the adoption of standardized regulations governing the weight, size and speed of motor vehicles is a problem that at this time is in urgent need of solution by the joint efforts of highway officials throughout the country, with the co-operation of the manufacturers and users of motor vehicles. The alarming rate at which motor-vehicle traffic is increasing, both in weight, size and speed, especially on the through-route interurban highways, demands the immediate establishment of some definite and equitable relation between permissible traffic privileges and the economic limits of road widths and their construction and maintenance.

It is my opinion that such standard regulatory measures should indicate the maximum allowable weights per vehicle, per axle, and also per inch effective width of tire. As a safeguard against possible road damage through excessive speed, all motor vehicles, and also trailers, should of necessity be equipped with rubber tires. The advisability of prohibiting the use of certain types of solid-rubber blocked or cleated tires should also be considered.

The definition of maximum allowable speeds should be governed by the consideration of safety, general character of pavement, and the lines and grades of the highways. The indication of maximum widths for vehicles is a very necessary precaution, as in many instances the traffic capacity of highways is being considerably reduced through the operation of vehicles of excessive widths. Allowable maximum heights and lengths of vehicles and the permissible number and total length of trailers should also receive careful consideration.

Until all of these features have been fully discussed by all interests concerned, and definite standards determined upon, it is certain that more or less misunderstanding and friction will exist between the highway officials and the manufacturers and users of motor vehicles, to their mutual disadvantage.

W. H. CONNELL,

Philadelphia.

Chief, Bureau of Highways.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

CONTRIBUTIONS to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.

Adjacent Earth Dam Utilized to Save Concrete Tower

BY H. K. BELL

President, The Bell Construction Company, Lexington, Ky.

ADVANTAGE was recently taken by the writer of an earth dam to the top of which, 30 ft. above an adjoining filter plant under construction, concrete materials could be delivered, to lay out an economical concrete plant which did not require a hoisting tower. It is especially important in building filter plants to have as few operations as possible in placing the concrete, as a breakdown of any link in the chain may delay work long enough to cause horizontal joints. Where the plant under construction is located on a watercourse, it is often possible to take advantage of a bluff to avoid the necessity for a hoisting tower and at the same time secure the advantages of gravity distribution for the concrete. The dam utilized in this way in building the filter plant shown in the photograph, which is an addition to an existing water, light and ice plant, was 24 ft. wide on top. Concrete materials could be hauled to the top of this dam practically without extra cost.

A wheelbarrow run was built from the top of the dam to the mixer tower, erected close to the filter plant and built high enough to bring the mixer 26 ft. above the ground level. From this height all the concrete was spouted to place except that for a small part of the roof. A chute from the mixer led to a hopper suspended from a cable in a central position, from which any part of the forms could be reached by a second chute. The

chutes and mixer could be gotten ready to concrete in about 15 minutes, which is a great advantage on this class of work. Often only half a dozen batches at a time are required, and it would be so expensive to rig up and operate the usual tower plant for such small sections that hand mixing would be necessary. Steam was supplied to the mixer on this work from the water plant.

The entire work was designed and carried out by the Bell Construction Company.

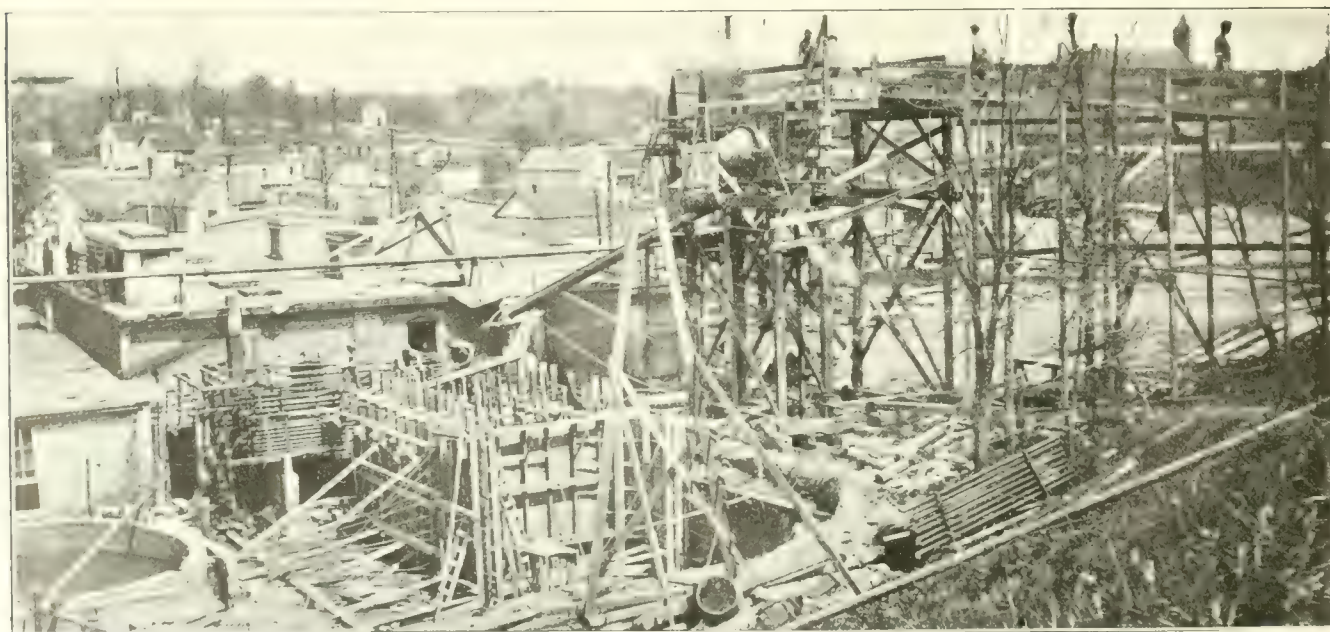
Brass Tack in Lead Wool Makes Easily Visible Instrument Point

By S. L. TOLMAN
Springfield, Mass.

A BRASS TACK driven into lead wool tightly packed into a drilled hole makes a semi-permanent instrument point which is easily visible.

Contractors' engineers are often obliged to set points on finished concrete in giving lines and grades for construction work. Chalk and pencil marks are soon obliterated, chisel cuts are hard to find or easily chipped and rendered indistinct unless the concrete has thoroughly hardened, and in some cases cannot be used because they would constitute a permanent defacement. A brass tack, on the other hand, always stays bright even if set in a floor, and is easily seen.

The method which the writer has found convenient for setting such tacks is to drill, preferably when the concrete is one or two days old, a small hole an inch or more into the surface. This hole is then packed full of lead wool, into which a large brass tack with a small head is driven. Such points may, of course, be used either as transit points or as benchmarks in horizontal or vertical surfaces.

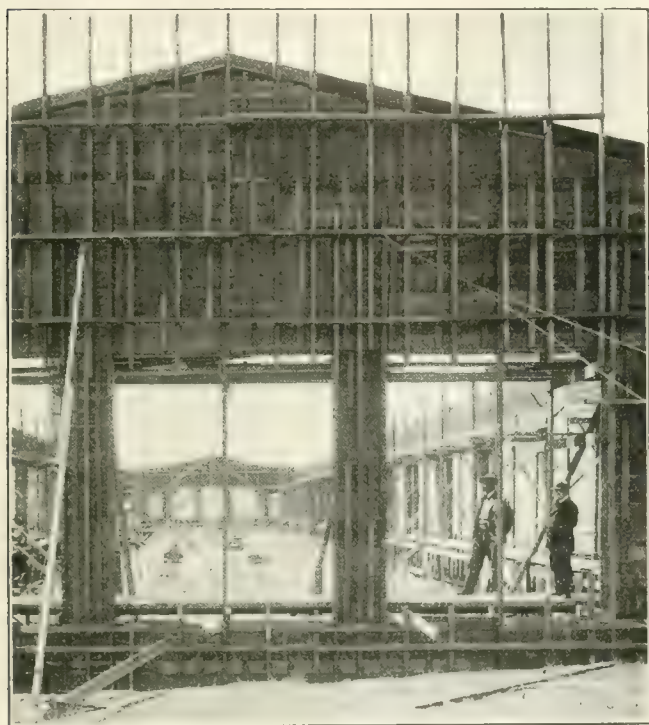


EXISTING DAM ABOVE FILTER PLANT TAKEN ADVANTAGE OF TO LAY OUT SPOUTING PLANT WITHOUT HOISTING TOWER

Built-Up Sections of Redwood Forms Used Repeatedly

REDWOOD forms for concrete which are built up in narrow sections are now being used over for the sixth time on building construction in the neighborhood of San Francisco. The idea developed last summer when an attempt was made to economize on form costs by putting up the forms carefully so the lumber could be used again. Redwood was selected because it was easy to handle and soft enough to permit of considerable nailing without splitting.

The first experiment was made on a structure with walls 22 ft. high and 280 ft. long. On commenting on the entire success of the experiment, the contractor on this job said: "After stripping we found no stains at



REDWOOD PANEL FORMS SUCCESSFUL IN CALIFORNIA

all in the concrete walls. The dampness on one side and the exposure to sun and air on the other seemed to affect the lumber very little and caused no warping as in other lumber, thereby giving a smaller percentage of waste."

It was found that by building up sections of the forms 2 ft. wide and from 10 to 16 ft. long it was possible greatly to reduce the cost of handling, and the percentage of breakage was less, because when handled in sections less nailing was required. The sections consisted of four 6-in. tongue-and-groove boards surfaced one side and $\frac{7}{8}$ in. thick. The boards in each section are held together with 1-in. cleats spaced 2 ft. apart. The sections are nailed to pine studding which is placed on 2-ft. centers instead of the usual 18-in., and the studs are in turn held by horizontal ties varying from 4 to 6 ft. apart.

Wires are run through the concrete in the usual manner to tie together the framing on opposite sides of the wall. Where the wall is interrupted by spaces for windows or other changes from a continuous surface, special short length sections are sometimes built, although it is

customary to put these in without the use of cleats, as shown in the accompanying illustration.

The cost of this tongue-and-groove lumber in San Francisco is about \$13 per 1000 ft. b.m., \$2 per 1000 more than the lumber ordinarily used for formwork. It has been estimated that the saving by the use of the built-up sections amounts to about 25 per cent of the cost of the forms. This estimate is based on the saving of labor in erecting the forms and the saving in breakage, which is very much less than with the usual method. Credit for the development of this idea belongs to Christensen Brothers, general contractors, of Oakland, Cal.

Movable Flume Saves Time on Hydraulic Fill Dam

DURING the construction of a large hydraulic fill dam recently completed in the West, considerable time was saved by the use of an inclined runway for the flume from which material was deposited on the dam. Although the flume was moved by hand, it was only necessary to interrupt the flow for short periods while the delivery flume was skidded along the incline to the desired new position.

Three borrow pits were used, from which, by means of hydraulic giants, material was sluiced into three main flume lines. From these mains the material was



DISCHARGE FLUME EASILY MOVED ON INCLINED SKIDS

conveyed through flumes along the upstream and downstream sides of the fill. By the use of gates the streams were discharged from the flumes at the desired intervals toward the axis of the dam.

A section of the distributing flume, shown in the accompanying photograph, indicates the inclined support. The flume box, 12 x 24 in. in section, was built up of 1 1/4-in. boards and was paved with 6 x 12 x 6-in. hemlock blocks set on end. Immediately above the blocks 1 x 6-in. projecting strips were nailed on either side. This box was supported on 2 x 6-in. stringers, which in turn were carried by 4 x 6-in. caps on the low sliding bents

spaced 15 ft. apart and inclined on a slope of 5 to 1. The 6 x 6-in. inclined caps were supported on pieces of the same size resting on the material previously deposited and tied together by cross-bracing.

The flume proper was moved up the incline by means of a lever and chain device at each bent. The lever consisted of an iron bar near the lower end of which was fastened a chain connecting with the framing of the flume box. At the extreme lower end of the bar a second chain was attached which passed over an iron claw fastened to the upper end of the inclined 6 x 6-in. cap. This lever was operated by one man at each bent. With the lever in an upright position, pulling it down through the quadrant, which it was possible to describe, would move the flume up the incline a few inches. This gain was then caught by taking up slack in the chain at the claw, and the operation repeated.

Short lengths of lateral flumes were attached to the openings in the upstream side of the flume box to facilitate control of the flow. Doors for closing the openings were provided so that material could be discharged at any desired point along the crest of the fill, a duplicate line of flume being used along up and down stream faces. Of course each time the flume was moved it was necessary to establish a new connection at the point where it was fed from the supply flume. Sluicing was carried on practically continuously night and day in order to save time, and the movable feature of the flume was considered to be a factor in the progress made on the job.

Harrisburg Bridge Centers Moved in Average Time of Six Hours

By FRANK P. KEMON
Atlantic City, N. J.

THANKS to well-arranged trucks and rigging, it was possible to move and replace in an average time for the entire work of 6 hours per change the large half-arch centers used in constructing the concrete bridge recently completed for the Cumberland Valley Railroad at Harrisburg, Pa. The bridge, which spans the Susquehanna River and measures four-fifths of a mile in length, was described on page 340 of the Engineering Record of Sept. 16 last.

As will be remembered from this article, the half-arch forms for this work consisted of lagging supported on curved strips and blocking carried by four 3-hinged steel arches which were tied across the bottom for moving with turnbuckle rods. As there were 45 arches, a total of 90 moves with these forms were required.

The trusses of the steel arch forms were bolted to 12 x 12-in. yellow pine stringers across each end, which supported them during moving and also while resting on other timbers carried by the brackets built into the side of each pier to support the centers during concreting. The moving weight of each of the 10 half-arch centers moved was about 18 tons. It will also be recalled from the article mentioned that the forms were handled from place to place by rolling them sidewise onto travelers on the construction trestle parallel to the bridge, pulling them along the trestle and rolling them back under the line of the bridge from the traveler at the new location. The elevation of the trestle was made such that the tops of these travelers were slightly below the seats on which the forms rested when in use.

In making the sidewise moves, the forms traveled on 2-in. pipe rollers which had been filled with cement grout to prevent their flattening. The pulling was done with two sets of falls at each end of the form, one set at each end to the near and one to the far side, which led to a locomotive crane on the trestle. The trucks on which the forms were moved along the trestle were made on the job from the wheels and axles of several 3-ft. gage dump cars. Each of them consisted of four 4-wheeled trucks, one under each corner of the form, running on the outside tracks of the trestle. Headroom was saved by making up each of these trucks in an ingenious manner. Short lengths of 60-lb. steel rail, one on each side of each truck, were clamped underneath the journals by U-bolts. On top of the rails rested 12 x 12-in. timbers connecting the pair of trucks at each end of the form. The rollers on which the



TRUCKS BUILT TO TAKE UP LITTLE VERTICAL SPACE

forms were moved sidewise bore directly on these timbers.

The crew usually employed to move these forms consisted of a rigger foreman, six riggers, an engineer and a fireman. Counting that the centers supported about 275 yd. of concrete at each location, the cost of moving and placing them amounted to about 6½ cents a yard. The bridge was constructed by the Robert Grace Contracting Company, for which the writer was superintendent under B. R. Hundley, eastern manager.

Rebuilt Concrete Mixer Cleans Ballast

An old rotary concrete mixer has been put to clean old ballast by the Kansas City Railways. The device is described in the *Electric Railway Journal*. The old mixer has been removed and a conical screen substituted. This screen is about 6 ft. long and tapers from 18 in. in diameter in the motor end to about 3 ft. at the discharge end. The same gasoline engine which formerly drove the mixer now serves as motive power for the screen. The ballast, salvage from track under reconstruction, or other material to be screened, is thrown into a wooden hopper built in at the small end of the screen, and as the screen turns is carried by gravity toward the discharge end. In passing over the meshes of the screen, the dirt is loosened from the rock and sifted through to the ground below, where it is taken up by workmen and carried away. The whole machine is mounted on a portable truck, making it possible to transport it easily from one job to another.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

\$4,250,000 Flood-Prevention Plan Presented

Los Angeles County, Cal., to Vote Soon on Project—Dikes to Cost About \$1,285,000

Damage from floods in Los Angeles County, California, can best be prevented, according to J. W. Reagan, county flood-control engineer, by diverting silt-carrying streams from the harbors, by constructing large storage dams and smaller retarding dams in mountainous areas, by straightening channels, by protecting banks and training the flow of larger streams, and by controlling and spreading smaller streams. Construction work costing approximately \$4,250,000 is recommended as imperative in his report to the board of supervisors. The board deems it advisable to include some additional territory in the district in need of protection. Mr. Reagan has been directed to prepare supplementary recommendations. When this has been done a bond election will be held.

Dikes Cost \$1,285,000

The suggested scheme includes a dike between Dominguez and Cerritos hills, north of Long Beach, to divert the Los Angeles and Rio Hondo Rivers into Alamitos Bay at a cost of \$1,285,000. Bank protection and the training of the Los Angeles, San Gabriel and Rio Hondo rivers would necessitate an expenditure of \$825,000.

Boulder levees or piling, brush and rock protective works along smaller streams emptying into rivers in agricultural districts, check dams in headwaters of mountain streams, and spreading grounds at the mouths of cañons would cost \$865,000, according to the report. A dam of concrete, or cyclopean masonry in Pacoima Cañon, about 5 miles northeast of San Fernando, is recommended. The structure will be 145 ft. high, 106 ft. thick, and 478 ft. long. Its upstream face will be arched on 400-ft. radius. The dam will form a reservoir having a capacity of 3200 acre-feet. Its cost is estimated at \$359,463.

Several Dams Suggested

Another dam across Arroyo Seco, near Devil's Gate bridge, about 10 miles northwest of Pasadena, is suggested. This barrier, according to the report, would be 130 ft. high, 98 ft. thick, 310 ft. long and the upstream face would be arched on a radius of 400 ft., with a 120-ft. spillway and a 20-ft. roadway on top. The reservoir capacity is estimated at 6557 acre-feet and the cost of construction work, \$290,000.

In San Dimas Cañon, near San Dimas, a dam 125 ft. high, 106 ft. thick,

265 ft. long on its upstream face, and with a capacity of 2500 acre-feet is thought necessary. Its cost would be \$278,000. An earth dam is recommended north of Pomona to be 40 ft. high, 16 ft. wide at the top, and 200 ft. thick at the base. The reservoir capacity would be 2250 acre-feet and the cost of construction work \$189,945.

May Vote \$15,000,000 Bond Issue for Washington Irrigation

Olaf Laurgaard, consulting engineer, of Portland, Ore., who has been making exhaustive investigations during the last year of the Horse Heaven irrigation project in Benton County, near Prosser, Wash., states that the proposition is entirely feasible. In his recent report he stated that 210,000 acres could be watered by gravity flow at a cost of \$45 an acre; the completed cost per acre, including storage, would be approximately \$81. The report gives complete data, including precipitation, natural flow of the watershed, storage facilities and engineering problems to be dealt with.

Stating that 20 in. an acre could be put on the 300,000 acres included in the district, Mr. Laurgaard advised that 210,000 acres he put under gravity flow first and that the project be completed when the land under cultivation justifies the expense. Estimates on two sizes for the main canal were submitted. One, carrying 1250 sec.-ft. of water, will cost \$9,476,000; another, carrying 1500 sec.-ft., can be built at a cost of \$10,445,000. The canal will be 120 miles long. The cost for storage reservoirs will be \$8,883,300. The total cost of the project will be \$24,553,000. Mr. Laurgaard's recommendation that a bond issue of \$15,000,000 be voted by the district has been taken under consideration by the board of directors.

Prices

of construction materials and an analysis of the railroad situation, indicating the possibilities of increased construction, will be found in the Contracting News section this week.

On pages 4 to 27 inclusive are the feature articles announced last week. Contractors will be interested in those on pages 7, 9, 11, 21 and 24.

California Commission Will Evaluate Water Property

500 Attend Spring Valley Company Hearing in San Francisco—Metering Thought Necessary

The opening session of the hearing before the California Railroad Commission in San Francisco, to determine whether the Spring Valley Water Company shall charge for its service in that city on a metered basis, was held on Dec. 27. So great was the interest in the case that only a small part of those desiring to hear the evidence could be accommodated in the commission's court rooms, and accordingly the hearing was adjourned to the municipal auditorium. The attendance there was about 500.

S. P. Eastman, vice-president and general manager of the company, testified that 65 per cent of consumers would save money by paying meter rates rather than flat rates. Max Thelen, president of the commission, stated the opinion of that body was that the service must be metered. The present minimum residence rate of \$1.80 per month is too high, he thought, and a new rate schedule would have to be determined by the commission. In order that this be done with fairness to all parties concerned, the commission decided that an exhaustive investigation of the company properties by commission engineers was desirable, but preferred that request for such investigation come from the company. In response to this the attorney for the company promptly agreed to file a formal application for such valuation. This valuation proceeding will be of importance to the city because the commission's findings will be very useful in negotiating for the purchase of the system.

Water Famine Probable in 1920

G. A. Elliott, chief engineer for the Spring Valley Company, stated that the present developed supply was being taxed to the utmost to provide sufficient water for the city. During 1915 the daily average was 42.6 million gallons. The maximum rate of supply which could be maintained at present, he said, was 44 million gallons per day, and consumption in excess of this has to be drawn from reserve reservoirs. The capacity of these reservoirs was only sufficient to supply the overdraft for a few years, and at the present rate of increase in consumption this reserve supply would be exhausted by 1920 or 1922 and San Francisco would face a water famine.

It is expected that the statistics, when prepared, will show a decreased consumption for 1916 because of the

close of the exposition, but the total during the first four months of 1916 was 4912 million gallons, as compared with 4798 million gallons during the same period of 1915. Relief from the present situation could be provided for, said Mr. Elliott, only by two methods—by building a new pipe line from Calaveras reservoir at a cost of approximately \$9,000,000 or reducing wastage in San Francisco. The installation of meters he estimated would decrease the water consumption from 5,000,000 to 7,000,000 gal. daily.

Exonerated for Damages Caused by Reservoir Failure

Holding that the Sweetwater Water Company's dam near San Diego, Cal., was constructed by competent engineers, and that the flood of last January which carried away a dike that formed a part of the reservoir was an act of God, a decision recently rendered in a San Diego court exonerates the company for damages to property below the dam. The suit was for \$13,000. Similar suits have been filed against the company for amounts aggregating \$200,000 and also against the city of San Diego for damages caused by the washing out of the city's Lower Otay dam. In this trial evidence was introduced that the rainfall on Jan. 27 was three times greater than ever before recorded for one day in San Diego.

Purdue Holds Road School

The annual road school at Purdue University will be held Jan. 16 to 18. The main topic will be road conditions in Indiana. Lectures by state highway officials will be illustrated with pictures of roads in Indiana. The annual organization meeting of the State Association of County Highway Superintendents will be held Wednesday evening, Jan. 17. The meeting of the Indiana Engineering Society also occurs at Purdue University Jan. 18 to 20.

Concrete Convention in Kansas City

The convention and show of the Southwestern Concrete Association will be held Feb. 19 to 24 in Kansas City. The program includes papers on concrete in all its various uses, as well as dissertations on tests of sand, cement and the uses of hydrated lime. Prof. Duff A. Abrams of Lewis Institute will speak on sand and concrete tests; Lieut.-Col. J. F. McIndoe, Corps of Engineers, U. S. A., will tell of the uses of concrete on government work along the Missouri River.

Flat-slab design is the subject of the paper by Arthur R. Lord of Chicago, while Prof. A. N. Talbot of the University of Illinois will discuss concrete columns. Fireproof construction will be detailed by Ernest McCullough, while A. N. Johnson has agreed to talk on concrete road design. The maintenance of concrete roads will be explained by George A. Ricker of the Portland Cement Association.

American Society Meeting in United Societies Building

For the first time the business sessions of the annual meeting of the American Society of Civil Engineers will be held in the United Engineering Societies Building, New York City, beginning Wednesday, Jan. 17. It is expected that plans of the proposed addition and a model of the completed building will be available for inspection. Excursions to view subway work and Hell Gate bridge are planned for the afternoon of the first day. The reception that evening at the house of the society, 220 West Fifty-seventh Street, will probably be the last in the old quarters, which have served for more than nineteen years.

The second day—Jan. 18—will be devoted to an all-day excursion on the Hudson and East rivers. R. A. C. Smith, commissioner of docks and ferries, has arranged for one of the municipal ferryboats to transport the visitors. In the evening, at the society house, J. Howard Whitehouse, member of Parliament, will discuss economic conditions in England due to the war, after which a smoker will be held.

Special Joint Committee to Make Final Report

The special committee on concrete and reinforced concrete will make its final report, which is printed in the *Proceedings* for December, 1916, page 1657. This committee, generally known as the "Joint Committee," here reports the results of four years' further investigation made since the progress report of 1912, presented at the annual meeting in January, 1913, and printed in the *Transactions*, Volume 77, page 385.

The most striking and valuable feature of the report is the new section on flat-slab design, to which more than eight pages are devoted. Definite design assumptions and formulas, based largely upon empirical treatment, are proposed. Various minor changes are made, but in general the design formulas, notation, etc., previously recommended are retained. Joseph R. Worcester is chairman of the committee, which consists of representatives from the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the Portland Cement Association and the American Concrete Institute. Richard L. Humphrey is secretary.

Lord Cowdray Given Charge of Aeroplane Service

Lord Cowdray, head of S. Pearson & Son, Ltd., of London, succeeds Lord Curzon as chairman of the air board, in charge of construction and equipment of all British navy and army aeroplanes. Lord Cowdray, whose biography appeared in last week's issue of the *Engineering Record*, is known in England as "one of the greatest organizers in the country." His new office is his first official position.

Consider Bay Bridge Near San Francisco

Three Propositions Submitted to Association Ranging in Cost from \$210,000 to \$797,000

A committee of engineers, made up of M. M. O'Shaughnessy, city engineer of San Francisco, Prof. Charles B. Wing, Stanford University, and Harlan D. Miller, bridge engineer, of Oakland, recently submitted a report to the Downtown Association of San Francisco on the feasibility of a highway bridge across the bay at Dumbarton Point, about 25 miles south of that city. The engineers reported that such a structure would be an aid to the government in providing for the defense of San Francisco Bay; that it would be of general benefit by bringing the Lincoln Highway directly into San Francisco; that it would provide a direct line of communication between San Mateo and Alameda Counties (a requirement of the state highway bond act); and that it would also benefit San Francisco and San Mateo Counties in providing a direct line of communication between the interior counties and the peninsula.

The Propositions

Three propositions were offered: (1) An agreement with the Southern Pacific Company whereby the present railroad bridge would be utilized for motor traffic as well as railroad traffic—estimated cost, \$210,000; annual cost, \$18,500 plus rent to the railroad; daily expense, \$80; (2) an aqueduct bridge, which is now being considered by San Francisco as a possible alternative to a pipe line around the southern end of the bay—cost, \$480,400; annual cost, \$29,436; daily expense, \$80; (3) a bridge for highway traffic only—estimated cost, \$797,200; annual cost, \$47,860; daily expense, \$130. The engineers recommended that a committee be appointed to make a detailed study of the project and report upon ways and means of establishing reliable estimates of costs and their proper distribution.

Will Spend \$100,000,000 on Steel Plant Improvements

The Bethlehem Steel Corporation has under way a program for additions and extensions at the plants at Steelton, Bethlehem, Baltimore, Lebanon, Reading, Quincy, Mass., San Francisco and elsewhere, involving an expenditure of about \$100,000,000 during the next two or three years. This expenditure will be made at the various steel plants of the company and at the coal and ore mines and shipyards controlled by the organization.

The Bethlehem Steel Company has acquired control of the American Iron & Steel Manufacturing Company plants at Lebanon and Reading and also the coke ovens and blast furnaces of the Lackawanna Iron & Steel Company at Lebanon, both owned and leased. No definite construction program has been developed for these two companies.

Big Increase Made in Tax on New York Motor Trucks

Ranging from a minimum of \$10 for a commercial vehicle with a combined weight and carrying capacity of 2 tons, and increasing by increments of \$5 per ton up to \$70 for gross loads of 14 tons, with an additional charge of \$10

old flat rate of \$5 per vehicle the new tax represents a big increase in the annual sums which motor-truck owners will be called upon to pay.

The new schedule also levies higher tribute upon passenger-carrying omnibuses. Henceforth they will be called upon to pay a minimum fee of \$15 for vehicles having a seating ca-

million dollars each year, now part of a general appropriation of \$3,000,000, be set aside for the special use of the highway department and that a straight appropriation of \$6,000,000 be made for road improvement work. He also asks that appropriations be made for the taking over of toll roads; that state highways be developed as rapidly as possible; and that the law preventing the state from aiding boroughs in building good roads be changed.

Engineering Society Activities

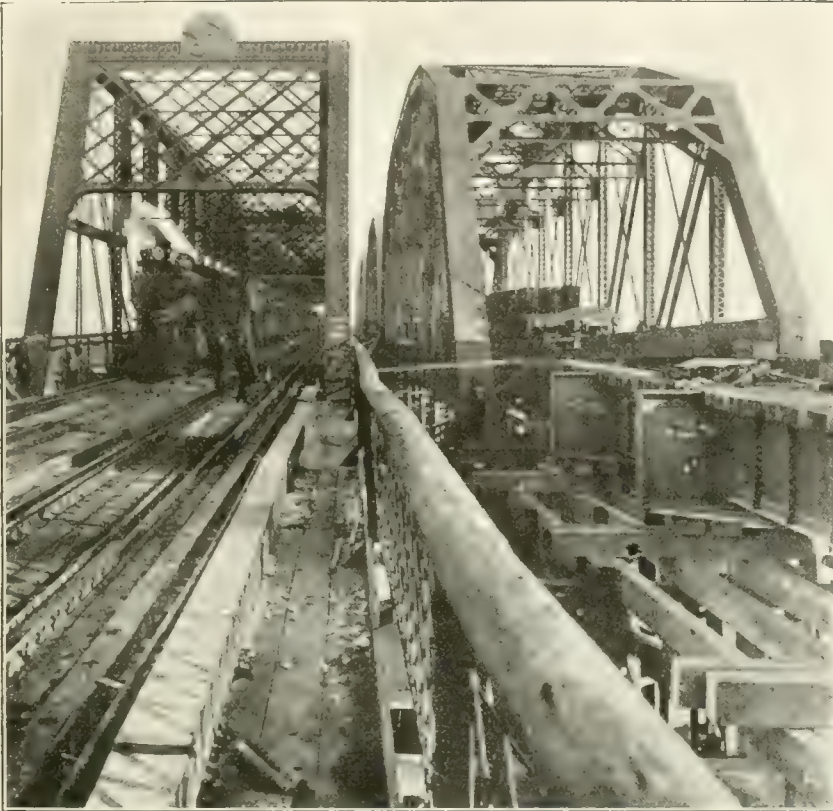
Western Society of Engineers' annual meeting and dinner will be held on Jan. 10 at the Hotel Sherman, Chicago. James Keeley, editor of the *Chicago Herald*, recently returned from the war zone, will speak on his experiences. Dean F. E. Turneure, University of Wisconsin, and Major-General Barry, recently assigned to the Central District, are also on the program.

Subdivision 63, Engineers, Chicago Association of Commerce, Dec. 20 elected the following officers for the coming year: I. F. Stern, chairman; Robert I. Randolph, vice-chairman; J. N. Hatch, Arthur Maldaner and W. W. De Bernard, members of the executive committee. The recent petition for an increase in salary of engineering employees of the city of Chicago met with the approval of the subdivision. An attempt will be made to gain the support of the association. The same action was taken with reference to the report of the bridge safety commission.

San Francisco Association of Members of the American Society of Civil Engineers at the annual meeting last month elected the following officers: John D. Galloway, president; H. J. Brunner, vice-president, and E. T. Thurston, secretary-treasurer. J. W. Swaren presented a well-illustrated lecture on "Undertones of Engineering," in which he outlined interesting features of construction work in Java, Sumatra, Philippine Islands and western America.

Southern California Association of Members of the American Society of Civil Engineers at a recent meeting in Los Angeles elected H. Hawgood, president, and Homer Hamlin, vice-president, for the ensuing year.

Florida Engineering Society was organized Dec. 22 and 23 at a meeting in Jacksonville, Fla. L. D. Smoot, commissioner of public works of Jacksonville, was elected president; W. P. Darwin of the same city and R. E. Chandler of Gainesville, vice-presidents; J. R. Benton of Gainesville, secretary, and H. D. Mendenhall, treasurer. It is the intention of the society to get the next Legislature to enact a law requiring engineers desiring to practise any one of the different branches of the profession in Florida to show necessary qualifications before being granted a permit.



Change Bridge at Omaha with One-Hour Traffic Delay

A NEW RAILWAY BRIDGE 1722 ft. long, 70 ft. wide, weighing about 5000 tons and costing \$1,000,000, was slipped onto the piers of the old one Dec. 22 at Omaha, Neb. The delay in traffic was less than an hour. The work was started at 11 a. m. and completed at 3.40 p. m., the same day. The new structure is designed to carry over the Missouri River the heavy traffic of the Union Pacific, the Chicago, Burlington &

Quincy, the Wabash, the Chicago & North Western, the Chicago Great Western and the Chicago, Milwaukee & St. Paul railroads. It is owned by the Union Pacific. Work was started last May. The new structure was erected on false piers and slipped onto the masonry of the old bridge. The old structure, which is in good condition, was considered too light for the heavy traffic. The daily traffic amounts to about 320 trains

a ton for weights in excess of 14 tons, the new schedule of fees for motor trucks in New York State, drafted by a special commission consisting of Frank M. Williams, state engineer, Gen. W. W. Wotherspoon, state superintendent of public works, and Edwin Duffey, state highway commissioner, was filed with the Secretary of State Dec. 29 and becomes effective Feb. 1. The new schedule, according to the terms of the legislative act creating the special commission, is required to be based upon "time and extent of use of highways" and "wear and tear" on roads. In the memorandum submitted to Secretary Hugo these matters are not mentioned nor is there anything said on the subjects of speed, tires, load per inch width of tire, overall dimensions or trailers. Compared with the

capacity of five persons or less. This tax is gradually increased to a maximum of \$67.50 a year for every vehicle carrying not less than 27 nor more than 30 passengers. For every passenger in excess of 30 an additional \$2 is required.

Wants \$6,000,000 to Spend on Pennsylvania Roads

In his annual message to the general assembly of Pennsylvania, submitted on the day the legislature convened—Tuesday, Jan. 2—Governor Martin G. Brumbaugh asked the law-making body of that commonwealth to give its attention to the questions of highway construction and the development of the state's water supply. The Governor asks that the state highway automobile license fund amounting to several

What Engineers and Contractors Are Doing

C. K. CLARK has been appointed chief engineer of the Imperial Irrigation District, succeeding Charles R. Rockwood. Mr. Clark assumed his new duties Jan. 1.

THOMAS W. HULME, general secretary of the Presidents' Conference Committee of the railroads, has been appointed vice-chairman of the committee.

H. C. PHILLIPS, assistant general secretary of the Presidents' Conference Committee, has been appointed general secretary, succeeding Thomas W. Hulme. Before his appointment as assistant general secretary Mr. Phillips was valuation engineer of the Santa Fé system, and prior to that he was chief engineer of the Coast Lines of the Santa Fé.

HERNAN LOIS and LOUIS MATTE, engineers in the employ of the Chilean government, are making a thorough study of American systems of irrigation and reclaiming arid lands. Considerable time was spent by the two men in the U. S. Reclamation offices, Washington, D. C. During the last few months they have carried on investigations in the irrigation districts of the West. At present they are visiting projects in Oregon which are completed or under way.

HARRY F. HARRIS, first assistant city engineer of streets of Trenton, N. J., has been appointed county engineer to succeed Theodore Tobish. James Ross has been appointed supervisor of roads.

J. W. KELSEY, formerly chief assistant to the engineer of design and construction of the St. Paul water department, has been appointed principal assistant engineer of the department, to succeed Roscoe L. Smith. After graduation from Virginia Polytechnic Institute in 1909 Mr. Kelsey engaged in the coal and iron business in Alabama. The following year he entered the U. S. Reclamation Service. A year on the Sunnyside project in Washington preceded his appointment in 1911 as assistant engineer for the Canadian Pacific Railway. He went to the Northern Pacific Railway in 1913, with office in St. Paul. Since 1914 Mr. Kelsey has been in the employ of the St. Paul water department.

GEORGE B. STURGEON, for the last ten years construction engineer at the University of California, has tendered his resignation, effective Jan. 1. Mr. Sturgeon will take charge of the construction of an irrigation system in recently opened tracts of farm land in southern California. While at the university Mr. Sturgeon acted as civil engineer of the architectural department and had charge of practically all construction work on the campus.

CHARLES H. SWEETSER, district engineer of the U. S. Office of

Public Roads, has opened headquarters in Berkeley, Cal., from which point he will direct road improvements in California, Nevada, Arizona and New Mexico. Under the federal road act the apportionment for the present fiscal year for the four states under Mr. Sweetser's supervision is \$362,711.

L. D. HOLLINGSWORTH was recently appointed division engineer of the Kentucky highway department with office at Paducah.

GEORGE F. BLACKIE, formerly engineer of roadway and track for the Nashville, Chattanooga & St. Louis Railway, has been promoted to assistant chief engineer.

C. P. ROSS has left the engineering department of the Union Pacific Railroad to enter the company's industrial department at Omaha.

L. D. BUSBY has resigned as chief sanitary inspector of the bureau of sanitation of Dallas, Tex. The office has been taken over by the superintendent of the street department.

H. H. TRABUE, formerly assistant chief engineer of the Nashville, Chattanooga & St. Louis Railway, has been made real-estate agent. He reports directly to the president.

JOSEPH H. O'BRIEN, engineer for Westinghouse Church Kerr & Company, has been made vice-president of the General Construction Company, of Harrisburg, Pa. Mr. O'Brien has been associated with Westinghouse Church Kerr & Company for the last fourteen years.

THOMAS H. MEANS, of Symmes & Means, consulting engineers, San Francisco, was recently appointed consulting engineer for the Anderson-Cottonwood Irrigation District at Redding. He succeeds H. H. Henderson, who resigned recently.

E. R. GAYLER has been appointed, by President Wilson, an engineer adviser to direct public improvements in Hayti in accordance with the recent treaty between the United States and the West Indian republic. Mr. Gayler is a graduate of Washington University, class of 1895. In 1902 he entered the Navy Department. Since then he has been engaged on the development of new naval stations. He is responsible for much of the work of that nature at New Orleans, Charleston and Pearl Harbor, Hawaii. For the last two years Mr. Gayler has had his headquarters in Washington.

C. H. HANSON has been appointed superintendent of the Bucyrus Development Company water plant at Bucyrus, Ohio.

JAMES C. TRAVILLA of St. Louis has become associated with the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, in the capacity of consulting engineer. Mr. Travilla is a graduate of the civil engineering department of the University of Pennsylvania. During his professional career he has been in the engineering department of the Missouri Pacific Railway, assistant engineer in the water department of St. Louis and was

for several years in charge of the estimating and drafting division of that city's street department. Later he was made superintendent of the street department and then street commissioner. Mr. Travilla resigned in 1913 as street commissioner of St. Louis and until 1916 had supervision and direction of the expenditure of \$1,000,000 for good roads in Tarrant County, Texas. He also directed road work in other Texas counties. In March, 1916, he was appointed consulting and associate engineer for a \$3,000,000 road system in St. Louis County, Missouri. This work was stopped by a ruling of the Supreme Court declaring certain road statutes invalid.

WILLIAM M. ACHESON resigned Jan. 1 as division engineer of Division 6, New York State Highway Commission, to become chief engineer of the Crescent Portland Cement Company at Wampum, Pa. Mr. Acheson received his engineering education at the Rensselaer Polytechnic Institute and Union University. He entered the employ of the Troy waterworks extension in 1900 as chairman and in 1902 had charge of the construction of the Quackenkill diverting dam. Two years later he went to the Isthmus of Panama as leveler. He was made acting resident engineer in the Bureau of Municipal Engineering in 1906 and in 1908, in the consolidation of departments and the reorganization, he was appointed engineer in charge of the third district of the Pacific division, which included the bureaus of municipal and sanitary engineering and building construction. In 1910 Mr. Acheson resigned to become supervising engineer of the County Construction Company. When the New York State Highway Commission was reorganized in 1913 he was appointed division engineer with headquarters at Buffalo.

R. S. WHITING, architect, of Grand Rapids, Mich., and formerly of Boston, has been added to the force of experts engaged in the trade extension department of the National Lumber Manufacturers' Association, with headquarters in Chicago. Mr. Whiting's work for the lumber men will be to study building codes, and assist architects who are trying to develop a model code for wood construction.

R. K. ROCHESTER has been promoted from superintendent of the Cleveland and Pittsburgh division of the Pennsylvania Railroad to succeed S. B. Robertson as general superintendent of the Central system.

GEORGE LE BOUTILLIER, formerly superintendent of the Logansport division of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, succeeds R. K. Rochester as superintendent of the Cleveland and Pittsburgh division of the Pennsylvania Railroad.

JULIAN C. FIELD & COMPANY, of Denison, Texas, has been retained to make surveys and report on a proposed toll bridge from Ardmore, Okla., to the Haulton and Fox oil fields. Field work has been started.

J. E. BEBB, office engineer of the

Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, with office at Duluth, Minn., has resigned effective Jan. 15, to take the position of assistant bridge engineer of the Michigan Central Railroad, with office at Detroit. Mr. Bebb is a graduate of the University of Cincinnati, class of 1905, and was connected with the Michigan Central for a number of years prior to his appointment with the Duluth, South Shore & Atlantic Railway.

R. S. CLAR, assistant engineer for the Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, succeeds J. E. Bebb as office engineer. Mr. Clar was graduated from Armour Institute of Technology in 1912 and soon thereafter went to his present employers. He was also engaged on railroad engineering work before completing his engineering course.

GEORGE MERCER, formerly general foreman for the Duluth, South Shore & Atlantic Railway and the Mineral Range Railroad, has been appointed superintendent of bridges and building, with office at Marquette, Mich.

W. WATERS PAGON, formerly a member of the firm of J. E. Greiner & Company, consulting engineers, of Baltimore, has opened an office in the Fidelity Building, in that city. Mr. Pagon was graduated from Johns Hopkins University in 1905 and later took a course at Massachusetts Institute of Technology. In 1907, after finishing his studies at Technology, he entered the employ of the Baltimore Bridge Company. Two years later he resigned to become associated with J. E. Greiner. Mr. Pagon is in a position to give special attention to the design, construction and maintenance of all types of movable bridges and to report on conditions and valuation of such structures.

JOHN A. BENSEL, formerly state engineer of New York, has been retained by the Board of City Commissioners of Bayonne, N. J., as expert in the proposed development of the South Cove section as a railroad and shipping terminal site.

EARL D. COVELL has opened an office in First National Bank Building, Missoula, Mont., for practice in water power, irrigation, water supply and municipal improvement engineering. After graduation from Ohio Northern University in 1906 Mr. Covell was assistant engineer of bridges and buildings of the Cincinnati, Hamilton & Dayton Railway. From 1907 to 1911 he was civil engineer and superintendent of construction for the War Department, in charge of construction of buildings, sewers, water supply, roads and water power at Fort Thomas, Ky., and in Yellowstone Park. From 1911 to 1915 he was engineer for the U. S. Reclamation Service in charge of surveys and construction on the Flathead project and division engineer on Saint Mary's canal. Since 1915 he has been in private practice in charge of construction under contract.

Obituary Notes

ROGER TAPPAN, a civil engineer formerly connected with the Eastern Railroad, of Massachusetts, the construction of the Hoosac Tunnel, railroad surveys in the Adirondacks and in various Western states, died recently at Natick, Mass. He was born at Marshfield, Mass., in 1848, and was a graduate of the Massachusetts Institute of Technology. For many years Mr. Tappan had devoted his time to painting, spending most of his time abroad.

EDWARD L. PEENE, superintendent of the Yonkers, N. Y., water bureau since 1897, died at his residence in that city on Sunday, Dec. 31, 1916. Mr. Peene succumbed to an attack of pneumonia, from which he had been suffering less than a week.

L. L. WILLIAMSON, for many years superintendent of the Terre Haute (Ind.) Water Company and later manager of the Helena (Mont.) Water Company, died recently in Terre Haute.

EDWARD JAMES JEFFERY, contractor of Portland, Ore., died in that city recently at the age of 81 years. Mr. Jeffery settled in Portland in 1863, and shortly after that engaged in the contracting business. He constructed tunnels for the Southern Pacific Railroad, a portion of Portland's sewer system, and was one of the builders of the first street railway on Washington Street in Portland.

GEORGE F. RICHARDSON, who served as county surveyor of Marin County, California, and city engineer of San Rafael for the past 20 years, died Dec. 20, at the age of 51.

EDWARD C. STEVENS, testing engineer for the R. W. Hunt Company, died Dec. 24 in Trenton, N. J., where he was working in the plant of the John A. Roebling & Sons Company. He had been in the employ of the R. W. Hunt Company about two years. Previous to that he served the Hazard Manufacturing Company and the Safety Insulated Wire Company.

JAMES SKENE, contractor, died Dec. 21 at Seneca, S. C., where he was doing work on the line of the Southern Railway. He was born in Aberdeen, Scotland, about 71 years ago. Mr. Skene came to the United States when a young man and spent most of his time in the West, where he was identified with important foundation work.

Civil Service Examinations

United States.—Examinations will be held Feb. 7 for positions with the Interstate Commerce Commission as follows: Civil engineer, salary \$720 to \$1,680; structural engineer, salary \$720 to \$1,680; electrical engineer, salary \$720 to \$1,680; mechanical engineer, salary \$720 to \$1,680. Form 2039 should be filled in by applicants for any of these positions.

Contractors' Equipment Companies Unite Sales Forces

The Lakewood Engineering Company has just announced that, in addition to its present line of contractors' equipment, it has assumed the sales management of Owens-Wylie concrete chuting systems and of Milwaukee and Wisconsin concrete mixers and street pavers. The new plan contemplates the development of an organization capable of building and marketing a complete line of contractors' equipment, and the volume of business, it is anticipated, will be sufficient to command the services of the best men in the industry.

The personnel of the new organization will be as follows: Charles F. Lang, president, Lakewood Engineering Company; N. F. Teschan, president, Milwaukee Concrete Mixer Company; Roy G. Owens, manager, contractors' equipment department; Lloyd Brown, manager car department; W. A. Meddick, assistant manager, car department; H. Walter Sykes, manager, electrical industrial equipment; W. G. Grail, manager, clamshell bucket department; V. Truelson, chief engineer, Milwaukee plant; James Lockhart, chief engineer, car department, Cleveland; Thomas D. Maley, chief engineer, contractors' equipment, Cleveland; Henry T. Pleines, general superintendent, Cleveland.

The slogan of the new organization will be "Link up with Lakewood."

New Reinforcing Plate Adds to Strength of Building

The Berger Manufacturing Company, Canton, Ohio, has brought out a new ribbed reinforcing plate named Ribplex. The design is a network of strands forming meshes between V-shaped stiffening or supporting ribs. These ribs have an inverted arch-shaped formation at their base, from which the turned-on-edge mesh strands start.

This combination is said to increase the strength greatly and make the plate more rigid. Ribplex is a combined centering and reinforcement, especially used for reinforcing floors, roofs, side walls, partitions, stucco construction, suspended ceilings, and practically all kinds of construction where concrete or plaster is used. The small meshes formed between the ribs prevent the soft concrete from running through, and make a good bond with the concrete so that it is possible to develop the full tensile value of the metal.

Truck to Mark Western Roads

A Federal motor truck has been specially equipped by the California State Automobile Association for marking and scouting roads in the coast states. On the running boards by the driver's seat are two large tanks holding more than 40 gal. One is for gasoline, the other for water. A third tank is extended from the frame on the left side of the truck to carry 5 gal. of oil.

With this equipment the truck will be able to travel from 400 to 600 miles without adding fuel or water.

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The Pork Barrel

IF PRESS REPORTS from Washington are to be credited, the President is considering ways and means of eliminating the "pork barrel." He has told the chairman of the House committee on rivers and harbors, so it is reported, that public-works expenditures should be administered by commissions, in whose charge would be placed the apportionment of lump-sum appropriations. Under the heading of public works would come the construction of public buildings, the improvement of rivers and harbors and the building of irrigation works. We sincerely trust that the report is correct and that the President will show the same zeal for this program as he did, mistakenly, for the eight-hour law. In the one course he would be as heartily commended as he was strongly condemned in the other.

A New Tax on Motor Trucks

ENGINEERS who may have been looking to New York State's special commission for guidance in determining how to tax motor trucks in proportion to the damage which they do to highways will find little to help them in the new schedule of fees submitted to Secretary of State Hugo, Dec. 29. As noted in the Engineering Record last week, page 39, the new scale of annual charges starts with a minimum of \$10 for a gross weight (truck and load) of 2 tons and advances by increments of \$5 per ton up to \$70 for a truck of 14 tons gross weight. Above this point the rate of tax increase doubles, amounting to \$10 per ton in excess of 14, plus the \$70 charge. The former state tax was on a flat-rate basis of \$5 per vehicle, irrespective of weight, so that after Feb. 1, the date when the new fees become operative, motor trucks will make a contribution to the upkeep of New York State highways substantially greater than they have in the past. At the public hearings on the schedule much time was devoted to discussion of size of truck, speed, total weight, weight per inch-width of tire, different types of tires, and other technical subjects. This was to have been expected, for the special commission was specifically directed to base its schedule upon "the time and extent of their [the motor trucks'] use of the public highways and the relative wear and tear of the public highways by reason of their use thereon." This was a big task—an impossible one, according to certain motor-truck men, but the commission offers no explanation of how "time and extent of use" and "wear and tear" entered into the grading of the charges it has fixed. Moreover, the report makes no mention of tires and springs, nor of trail-

ers. Considering the discussion which preceded its promulgation, the report and the schedule are distinctly disappointing.

Export Trade

SO MUCH has been said in these columns about the stabilizing influence of export trade and the consequent effect on our economic life, that no excuse is needed for referring again to the vicissitudes attending upon the passage of the Webb Bill through Congress. That measure, as the readers of this journal know, would allow competing firms to combine for the extension of foreign trade. The bill has passed the House and is now in the hands of the Senate committee on interstate commerce. The House, however, added two amendments, one of which would vitiate the measure and defeat its purpose. That amendment provides that an export association may not engage in "trading in or marketing" within the United States. This clause was designed as a precaution, additional to the Sherman and Clayton acts, against restraint of domestic trade, but it would operate, if enacted, to prevent the export association from buying the very goods it is organized to export. Unless this clause fails in the conference, provided, as is hoped, that the Senate committee will not report it favorably, the measure might just as well not be passed. It is exceedingly important to the welfare of the small manufacturer who cannot by himself engage extensively in foreign-trade promotion that export trade combinations be made legal.

Military Engineering on the Border

IN his account of what the 22d New York Engineers did during their half-year of service on the Mexican border, the first part of which appears as the leading article in this issue, Lieut. C. E. Bregenzer describes the varied services which military engineers are called upon to perform. Water was the first big problem, but at McAllen, Tex., unlike the case of the mobilization camp at Beekman, N. Y., it was a question of getting rid of water rather than of securing it, and the engineers were in great demand. Then there were manifold duties in connection with the camp water supply, roads, bridges, sanitation, trench work, and the building of mess shacks, hospitals and other structures. In the second installment of the article, to appear next week, Lieutenant Bregenzer suggests the advantages to be gained by a more extensive use of contractors' plant and equipment in military-engineering work. The military engineer of the old school is prone to rely exclusively

on hand labor. Quicker and better results can often be secured by the judicious use of mechanical equipment. This view is supported by H. G. Wells, the noted English author, who says in the *New York Times* of Jan. 7: "The decisive factor in the sort of war we [the English] are now waging is the production and right use of mechanical material. . . . The disposition of the military expert is still to think too little of machinery and to demand too much of men."

American Society's Valuation Report a Praiseworthy Document

CREDITABLE indeed is the adjustment of the depreciation controversy in the new report of the valuation committee of the American Society of Civil Engineers. The committee's own abstract of the report is published on page 59 of this issue. When the storm of protest broke three years ago over the first report, its center was the treatment of depreciation. The impression made was that the committee failed utterly to make any distinction between kinds of utilities, and accepted the view of the so-called public side, that accrued depreciation must in all cases be deducted to satisfy the courts, regardless of past regulation or the lack of it, of the impossibility or undesirability of maintaining property in 100-per cent condition, and of the evident confiscation in many cases of a part of the property by the deduction. A brand new accounting method, the "equal-annual-payment" method, was introduced, and pages and tables were devoted to its exploitation, without, however, convincing many readers of any advantages of the method over more easily understood systems. The trouble seemed to be fundamental. The report was written from the waterworks angle, with little regard for the very different conditions controlling railroad valuations. The three new appointees, however, were known to have the railroad point of view; hence the expectation of a lively controversy in the committee.

Both sides, nevertheless, have emerged from the fray with honor. Neither is decisively defeated. Nor yet has there been ignominious compromise such as would have resulted in an evasive and meaningless document. The forty-eight meetings and thirteen volumes of correspondence testify to the painstaking efforts. And as the report is read the fact is revealed that both sides have retained the essentials of their cherished views. The equal-annual-payment method, under a new name, the "compound-interest" method, is shown to be logical and superior to other methods for properties or items requiring accumulating funds to take care of final renewals. It is shown to be desirable where regulation has allowed or is allowing an annual charge for a renewal fund, or where, as in the case of a few large items of plant, safety requires provision in advance for their renewal. The committee presents substantial argument for deducting depreciation from the rate base under such conditions, crediting back such money as is found in public service, either as a separate fund or as

additions to plant. This accords with the committee's original views as applied to such utilities as waterworks, subject to wide fluctuations in renewal demands. On the other hand, the committee recognizes the different conditions applying to railroads, because of the uniformity of their annual renewals and the absence of any provision or need for provision for accumulating funds. Therefore it exempts the railroads from depreciation deductions in rate cases, and meets the railroad view that renewals should be treated simply as a form of maintenance.

The success of the committee's members in adjusting their views is attributable to the admirable analysis of the fundamentals of depreciation. The first report plunged into the intricacies of depreciation accounting after barely a page devoted to fundamentals. The new version devotes fifteen pages to the fundamentals, and by its clear analysis of the bearing on the problem of the character of the utility, its parts and the regulation under which it is operated, in conjunction with those three happy terms, *decretion* (the cause), *accounting depreciation* (the record), and *depreciation of valuation* (the amount sought), prepares the reader to comprehend and approve the favored accounting method with comparatively little explanation.

This journal has been of a somewhat different opinion regarding the deduction of depreciation. It has felt that, except in the case of properties having very large items of plant, such as waterworks pumping stations, which could not be renewed except by renewal funds carried many years, it need not concern the public whether the owners elected to hold their renewal funds intact, invest them in plant or distribute them and make up the deficit by foregoing dividends when the renewals became due. It concedes, however, that this method is not altogether safe, and with the deduction of depreciation based squarely on whether depreciation allowances are or ought to be allowed, it sees no hardship in the committee's proposition.

Not only the depreciation section but practically the entire report has been rewritten and rearranged. In part this has been merely to clarify the views previously advanced; in part, to bring the discussion abreast of developments of the last three years. The valuation of land, for instance, has been debated many times in that period, due mainly to the many interpretations of the Minnesota rate decision. The railroads have not had signal success, because they appear to be trying to get, under another guise, what they were denied by Justice Hughes. The state commissions wish to strike off everything except the naked normal value. The committee finds the allowance of all real items of cost, including the compulsory feature, severance damages and the cost of acquisition, compatible with the Minnesota decision, but—and here it departs from the railroad view—it rejects the theory of an additional value attaching to the property because of its higher use. The *Engineering Record* is in hearty accord with the committee's entire land discussion.

The whole report leaves little to be desired, and the Engineering Record hopes it will be accepted by the society at an early date.

Compensation of Engineers

TWO YEARS AGO, when the special committee on compensation of engineers made its second progress report to the American Society of Civil Engineers, considerable information in addition to that of the first report was presented, and hopes were raised that more representative figures were to be obtained by a thorough canvass of the army of non-members of the society in the employ of large corporations and governmental organizations. These hopes are scarcely realized by the addition of 1582 replies, or an increase of 33 per cent over those previously reported. The committee thinks the additions have not materially affected the averages, but surely there is ground for contention that reductions of more than 10 per cent are material.

Looking at the latest diagrams one sees at once that the irregularities have not been materially reduced. In Diagrams 1 and 2 (see page 68), for instance, there is no logic in the peaks for the average curve at 18, 25, 29 and 31 years. Likewise who can explain why in Diagram 3 the two curves come almost together at the fifth period? Or why in Diagram 4 the contractors' curve drops violently at the fifth period and then immediately recovers, the railroad curve following suit five years later? Obviously the only answer is insufficiency of data and the domination of a few high incomes.

This domination shows plainly in Diagram 1. For the first 25 years it is not so marked, but even here the bumps in the average curve match those in the maximum. For example, with a peak in the maximum at 2 years the average is \$70 or 5 per cent above the mean between 1 and 3 years; at 10 years, another peak, it is \$152 or 6 per cent above; while at 18 years, a high peak, it is \$775 or 17 per cent above. Beyond 25 years, as the number of replies in each group diminishes, the irregularities increase.

Much interesting information can be gleaned from a comparison of these diagrams with the corresponding ones of two years ago (see the Engineering Record of Jan. 30, 1915, page 139), even though the committee does not regard the changes as substantial. In the early years, where there are no extraordinary maximums, the reductions are small, though positive; but at 18 years, when the first \$150,000 income is reached, 51 new replies reduce the average \$387, and at 29 years, another peak, 18 new replies cause a reduction of \$1,026, or more than 10 per cent. An interesting sidelight on this diagram is the raising of the 20-year average by \$62—explained probably by the committee's discovery of a new high man outside of the society at \$57,500, ousting a mere \$25,000 engineer.

Diagram 4 and its counterpart of two years ago furnish further evidence of the inadequacy of the data. Of the 1582 new replies 25 are contractors—a reasonable increase in the smallest group. Only one new consulting

engineer, however, has been added to the 619 already listed, while the lower-paid groups are increased by fifties and hundreds. In other words, the committee evidently had practically all of the prosperous consulting engineers two years ago, but who will suppose that there are almost as many consulting engineers as engineering employees of municipalities or of railroads?

The truth is in all probability that the rank and file of those following civil engineering have not yet come to the committee's attention. The committee canvassed fifteen local engineering organizations. Probably the vast majority of engineers belong to no society whatever. The committee states that it could not get the necessary co-operation to list the men in large corporations or public organizations. Was that universally true? Could it not profitably have included a few such groups? For example, the annual reports of the New York State Engineer publish the compensation of all members of the department. A hasty census by this journal of the engineers reported in 1915 in the Eastern District showed 253 men following engineering, from deputy state engineer to chairman. Their average compensation was \$1,775. Only eight were up to the committee's average of \$3,986. Of these 253 men only 44 were found in the membership list of the Society, and they averaged \$2,857, leaving an average of \$1,547 for the other 209. This suggests the unreliability of returns mainly from members of the society.

The committee suggests that many of those who have commented on its previous reports were men doomed to failure in any profession. Judged by the standing attained by the members of the committee, that is probably true. For that reason it may be unfortunate that the committee was not made up in part of men of lower rank. Executive and administrative ability is found in comparatively few. Many who have little of it, and can never be powers in the engineering profession, are nevertheless industrious, faithful, technically sound and reliable for important detail work. Are they failures? And do they fare as well as men of similar characteristics in other walks of life? Not a few of them believe they do not, and it is harsh of the committee to say that their comments should be given little weight.

It is further suggested that the eagerness of young men to adopt the civil-engineering profession is due to the quickness with which they reach a self-sustaining basis. May it not be due in part to an exaggerated idea of the fruits of engineering, and will there not be an inrush of young men who read that the average compensation of civil engineers is \$3,986 per year? The Engineering Record would like to believe that the figure is correct, but is far from convinced that it is even \$3,000. Until a far greater number of the untitled employees of large organizations are included in the diagrams and the kinks are straightened out it will be hard to believe that the curves are representative and trustworthy. Therefore it is the hope of this journal that the committee will withdraw the report and seek new ways and means to record these many missing members of the profession.



CAMP OF ENGINEER TROOPS AT THE BORDER

On the Mexican Border with the 22d Engineers

Part I—Drainage Was the First Problem Which the Troops Faced—Five Bridges Built — Water Supply Installed — Mexican Labor Employed on Some Work

By C. E. BREGENZER

First Lieutenant, 22d New York Engineers, N. G. U. S.

PREPARED and hardened by strenuous work in connection with the installation of water supply, road work and other engineering duties at the mobilization camp at Beekman, N. Y., described in the Engineering Record of July 1, page 3, the first battalion of the 22d New York Engineers entrained for the Mexican border on July 12, followed two days later by the second battalion. The first engineering duty required was drainage work, for the arrival of the regiment was coincident with the beginning of the rainy season, when a torrential downpour registering a 2-in. precipitation in about 18 hours caused many washouts.

DRAINAGE THE FIRST PROBLEM

Located at the base of a slope, the engineer camp was subject to inundation from the back waters of the Rio Grande. The ground does not absorb water, but is adobe, similar to the gumbo flats of Missouri. While the rain was pouring, the officers, equipped with rubber boots and raincoats, went out to determine natural water channels, in order to avoid flood recurrences. Levels were run the next day and a 2 x 3-ft. drainage ditch was staked out and dug along the northern part of the camp.

In places where the ground profile prohibited depth of ditch, dikes were constructed. Laterals were also dug along the company, regimental and headquarters streets, and all tents were ditched. The ditching, done by the men, saved the camp from flood troubles for the time being, but the heavy, continuous rains soon caused the water to back up in the valley, making it necessary to abandon the camp site.

One of the worst sufferers from the rains was the 12th New York Infantry. A large lake formed at the western end, or foot, of the company streets, flooding many of the tents and rendering the streets unfit for travel. Relief was first sought by drilling a hole with a well-drilling rig near the center of the lake, with the hope of penetrating a water-absorbing stratum; but beyond filling the hole, no results were achieved.

By a process of elimination, the officers of the regiment finally decided to dig a drainage ditch. At the

foot of a long slope, with hardly perceptible fall, is located one of the main irrigation canals. Permission was granted to break through this canal. Requests were made to the engineers for transits and levels, and a detail of officers and men was sent. The measured distance from the edge of the lake to the center of the irrigation canal was 1475 ft., and profile readings indicated that a grade of 0.3 per cent was possible, draining the deepest part of the lake, about 2.5 ft. Grade stakes were set every 50 ft. The men of the 12th Infantry were furnished with picks, shovels and spades, and began the heavy task of digging the ditch, which ranged from 2 to 9 ft. in depth, except the canal dike, where it was 14 ft. An average bottom width of 2 ft., with 1 on 1 slopes, was maintained. According to military custom, where men are plenty and quick results are sought the men were divided into two working parties, each working and resting thirty minutes alternately.

PICK-AND-SHOVEL WORK EXHAUSTING

Without intended criticism, as the men worked hard and willingly, it became apparent to one familiar with excavation methods that this body of men was not responsible for any of the pipe lines or sewer trenches in our cities. They were speedily exhausted and achieved poor results, simply because they did not know how to use a pick and a shovel to advantage. It became necessary for the engineer officers to instruct them and to explain such matters as tool ratios, proper spacing to prevent injury and finally the necessity of benching. The same conditions obtained among engineer soldiers, and it required some time to instruct them. Once they acquired the knack, their native intelligence speedily made them efficient.

About 600 ft. of this drainage ditch, adjoining the irrigation canal, was let to a Mexican contractor, who did the work with Fresno scrapers, mule teams and plows. Experiments were made to break through the dike of the canal with explosives. Troto gelatine was used, but the action of this explosive is upward, and it gases too rapidly for effective work. Blasting powder would have handled the situation. With the combined

methods described the whole work was completed in about a week.

As the drainage ditch bisected the camps of the 12th Infantry and 4th Ambulance Company, it was necessary to bridge it with five bridges to establish intercommunication. They varied from 12 to 36 ft. in span, and were of the beam-and-trestle type, 18-ft. roadway, and were formed of 6 x 6-in. stringers, spaced on 2-ft. centers, resting on three 6 x 6-in. sills supported by cribbing. The floors consisted of 2 x 10-in. planks; 6 x 6-in. guard rails were added, as well as handrails, the latter constructed of 2 x 4-in. lumber. One of these bridges was built between 8 and 10:30 p. m., by lantern



ENGINEER SOLDIERS WERE DETAILED TO LAY WATER PIPE

light, the work being done by a detail of twelve engineer soldiers.

The trestle bridge consisted of three bays, 12 ft. to the span, resting on two 6 x 6-in. sills and two framed trestles of 8 x 8-in. timbers, made up of two plumb and two batter posts. The stringers were formed of 3 x 10-in. timbers spaced on 18-in. centers, with 2 x 10-in. planking for the floor.

DATA GATHERED ON EXISTING BRIDGES

A bridge detail, consisting of master engineer sergeants and privates, was sent out to gather data in reference to all types of railroad and highway bridge structures in that section of the border under control of the New York division. Sheets were prepared showing stress analyses, type of bridge and materials of construction.

Most of the highway bridges were very light, the stringers usually consisting of 2 x 10-in. planks, with the same dimension for flooring. Some of these, especially along the main line of traffic, had to be entirely rebuilt, and nearly all had to be stiffened to accommodate the motor-truck traffic.

Concrete finds little application in bridge or other army construction. Sand is expensive and a little too fine for good results. The nearest stone outcrops were about 18 miles north and west of McAllen. Sam For-dyce, about equidistant, has some very fine gravel pits.

Many of the culverts are of the corrugated, galvanized-iron type, but lack proper covering. On the West McAllen and Hidalgo roads these had to be covered

prior to the maneuvers held at Hidalgo. The bridges on these roads had also to be rebuilt, repaired or stiffened in order to accommodate artillery and supply trains. One company of engineers was assigned to a road, and the work was completed in twelve working hours. The mounted section of engineers did good service here, preceding the main body, with wagon escort, and leaving necessary timbers at sites. They also handled the lighter repair work.

TACTICAL PROBLEM WORKED OUT

Two maneuvers were held at Hidalgo, located on the Rio Grande and opposite the Mexican town of Reynosa. The objective of the tactical problem was to effect a theoretical crossing of the river, the banks of which are rather friable and abrupt. The river is about 500 ft. wide and has a current of approximately 7 miles an hour. The offensive force consisted of a reinforced brigade, with all arms of the service represented, a company of engineers being detailed to act with the advance. On the capture of Hidalgo, they carried out the practical part of the theoretical crossing by constructing a fascine raft made from willows, which grow in profusion. The fascines were bundled in chokers, hurriedly constructed of poles. The raft proved suc-



TO UNWATER THE 12TH INFANTRY CAMP A DRAINAGE DITCH 1475 FEET LONG WAS EXCAVATED

cessful, having sufficient bearing power to support ten men.

WATER SUPPLY

One of the important problems at McAllen, as at Camp Whitman, New York, was the water supply for the various units encamped there. These consisted of Division Headquarters, Signal Corps, one ambulance company, field and base hospitals, 7th, 12th and 13th Regiments of Infantry, 1st Regiment of Cavalry, Squadron A, 1st and 2d Regiments of Field Artillery and a regiment of engineers.

The only available source of water supply is from the city waterworks, supplying a town of about 2000 inhabitants. Few of the Mexican residents of the town use this water. The system had to be expanded to serve a population of 10,000, a problem which was solved without entailing any suffering due to lack of water.

McAllen receives its water from two wells, driven to a depth of 98 ft. Underlying the town site for a width of about 600 ft. there is a gravel intrusion from the Rio Grande, the waters of which seep through. The

wells are equipped with deep well-pump heads, from which the water is delivered to a standpipe 85 ft. high, having a capacity of 100,000 gal. At first the water was unpleasant to the taste, as is common in alkali regions, especially when warm, but was pronounced wholesome by the medical authorities. It contained an excess of magnesia salts, but the men readily learned the neutralizing effects of lemons, and this simple lesson in chemistry found wide application.

At the time the engineers arrived at McAllen the units enumerated were supplied from a 2-in. pipe line connected to the city mains. This line was located along the regimental streets, a $\frac{3}{4}$ -in. riser and bibb being



IN TACTICAL-PROBLEM WORK THE ENGINEERS HAD TO BUILD MANY BRIDGES

provided for each company kitchen. The arrivals of additional troops and stock soon taxed this line to the limit, and as showers were planned, a new supply line was decided upon. One of the engineer officers was detailed to headquarters to supervise this work.

The new extension called for a 6-in. line from the pumping station to the first company street of the 7th Regiment, thence parallel to this street to its end, there a reduction to a 4-in. line to a point at the south end of the 71st Regiment camp, then a 3-in. line for the 1st and 2d Field Artillery and Squadron A. Traverse surveys were made from the new location of the 1st Cavalry and engineer camps, and the calculated closing line of this area became the location of a 6-in. line 2800 ft. long between the engineer camp and the end of the 6-in. line at the 7th Regiment. The projected lines were staked out, but no profile was run, as the ground has an even surface.

EXPERIENCE WITH MEXICAN LABOR

The contract for excavating the pipe trenches was let to an American contractor, who employed Mexican labor. The padrone system obtains, the laborers receiving \$1 per day. They were a motley and picturesque crowd, ranging from grizzled old men to boys, many of them only shod with sandals. They all have the *mañana* habit, and it required a clever foreman to get a day's

work out of them. The common method is to give them station work, a task of so many hundred feet, upon completion of which they may go for the day. Some thirty of these Mexicans were assigned to an engineer officer on a piece of work, the completion of which was urgent, but as soon as their padrone turned his back they began leaning on their picks and shovels. None too familiar with vernacular expletives, he simply ordered them out of the trenches and substituted engineer soldiers. In the belief that they had lost their jobs, they soon returned to work with considerable vigor. In their work they used pick mattocks and long-handled shovels.

During the progress of excavation work on the trenches, pipe was distributed along the side by motor trucks. At spots determined beforehand, tees, unions, gate valves and expansion joints were left, to be fitted in as the pipe gangs advanced. Engineer soldiers were detailed to do this pipe work, their tools consisting of Stillson wrenches, chain tongs and ball peen hammers, the latter used mostly for loosening tight thread guards. Here, as at other times, it developed that practically all trades were represented in the Engineer Corps. There were at least a dozen expert pipefitters, with experience on either steam or water lines. They handled the work well, one detail of fourteen men laying more than 2800 ft. of 4-in. wrought-iron threaded pipe in one working day. It must be remembered that the working day had to be shortened, as at times the thermometer rose to 145 deg. Fahr. The usual working hours were from 7:30 to 10:30 a. m. and from 2 to 4:30 p. m. A pipe-fitting shop was rigged up at the pumping station, and consisted of a pipe vise and a hand-threading machine. The engineer detail stationed here cut and threaded all pipe used for fillers and all fittings. A pipe-fitting arrangement on the combat wagons would have saved some time on this work.

ONE SHOWER BATH PER BATTALION

Three ten-head shower baths were allowed for each regiment, one to each battalion. It developed in course of inquiry that each unit had plumbers and pipefitters, so the engineer officer simply made a dimension sketch on the inside cover of the valve control box, together with the bill of materials required. The pipe and fittings were then drawn by the regimental supply officer and placed by men of the regiment. An inspection revealed very workmanlike execution of the sketch. About 2000 ft. of the line, extending from the 7th Regiment to the engineer camp, was 6-in. cast-iron bell-and-spigot pipe; the remainder wrought-iron, threaded. On the threaded pipe no white or red lead or other compound was used, as the pipe rusted in very quickly, and no leaks developed.

The laying of the lines to the Engineer and 1st Cavalry camps was let, the work being done by Mexican labor, on the station plan. It is said that the trenches were dug and the pipe laid and covered for a trifle over 3 cents per foot. An engineer officer was detailed as inspector on this work. This new pipe line and the drilling of a third well, near the pumping station, relieved any existing dearth of water.

Outside of detailed mapping of extant lines, no water-supply work was required of the Engineer Corps at Mission and Pharr, where the remaining units of the

New York Division were encamped. At both these places the source of water supply is from canals on the irrigation system, supplied by pumping stations on the Rio Grande. From the canals the water is pumped into tanks and distributed by gravity. Pharr has sedimentation basins.

WATER FOR "HIKING" CIRCUIT

Water-supply work was further required at La Gloria and Laguna Seca, both points on the "hiking" circuit, where troops camped while making the prescribed ten-day march under full equipment. La Gloria, located 22 miles northwest of McAllen, in the "hinterland," was also chosen as a site for the artillery and infantry rifle ranges. This place is not a town or hamlet, as one may be led to infer, but simply a windmill. It had been a Mexican bandit rendezvous, and the marks



IMPROVISED CHOKE FOR MAKING FASCINES FOR RAFT

of their hurried exit from the Rangers can still be seen in bullets embedded in the windmill structure.

A company of engineers was detailed to this place to install a power-pumping plant and storage tank. The prime mover was represented by a portable 4-hp. contractor's gasoline engine and a deep well-pump head, both of somewhat remote pattern.

It required a two-day march to reach this place. On arrival the windmill was repaired and tests were made as to capacity. The mill developed about $1\frac{1}{2}$ gal. per minute under average wind conditions. Four machinists were found in the company who had had gasoline-engine experience and they undertook to get the engine in running order. It was found that the compression was good, but some essentials were lacking, among them batteries, spark coil, spark plug, gasoline tank, oil and gasoline. The valves needed grinding and the spark-timing device repairing. An estimate was made of the articles required, also necessary pipe fittings, pump rods and tank, and an officer was dispatched to Sterling's Ranch to order them. In the meantime, an old water hole, used for storage, was cleaned out, as it proved a prolific breeding place for mosquitoes. A timber head of 6 x 6-in. lumber was also constructed in the windmill structure for mounting the pump jack. After twenty-two working hours the engine was repaired and running, and was belted to the pump jack. The stroke of the pump rods was increased from 11 to $19\frac{1}{2}$ in., and the power-equipped well developed 10 gal. per minute. An 1800-gal. tank was installed, the casing lengthened and connected up. A thatch roof was also erected over the tank.

Although this water came from a rock foundation and a depth of 120 ft. it was not very cool and had a very salty taste.

To those accustomed to calculating water supply on high unit figures it may be of interest to note that at one time a battery of artillery, consisting of 150 men, a company of infantry, 90 men, and a detail of 60 engineers, together with 90 horses, used this well as their sole source of water supply for several days. A guard was placed at the tank valve, and such luxuries as washing and shaving were dispensed with.

The seven windmills at Laguna Seca were badly damaged by the West Indian hurricanes, which blew at the rate of 80 miles an hour. An engineer detail of seven men was sent out in a motor truck to make hurried repairs. On arrival they found that several repair parts were essential, and water as well. They installed a rope drive, using the jacked-up rear wheels of the motor truck as a prime mover, which proved successful.

On account of the uncertainty of finding suitable water when out on detached work, the engineer troops took a tank sprinkling wagon along with them. This saved much time, especially in choosing a suitable camp site.

(To be concluded)

Prof. Whipple Reports on New York's Proposed Garbage-Reduction Works

Expert Predicts That Plant with 2000 Tons Daily Capacity Will Be a Nuisance at Times—
Staten Island Site Not Best, He Says

THAT Staten Island is not the best site, from the sanitary standpoint, for New York City's large garbage-reduction plant, which has been a storm center of protest and litigation since the contract for its construction and operation for a five-year term was awarded last April, is the opinion expressed by Prof. George C. Whipple of Harvard University, consulting engineer of the firm of Hazen, Whipple & Fuller, in a report submitted last month to Linsly R. Williams, deputy commissioner of the New York State Department of Health. While the proposed plant, which is to have a daily capacity of at least 2000 tons, will constitute no menace to health, according to Professor Whipple, it will, at times, be a nuisance within the meaning of the Public Health Law and the penal statutes. Odors may be expected periodically from the works themselves and also from the scows which will deliver the garbage from dumps along the city's water front via New York Harbor and the Kill van Kull. Professor Whipple believes that the Cobwell process of reduction, which it is planned to install at the Staten Island plant, "is the best method now known and available for the disposal of the garbage of the City of New York," but he contends that the plant should be located either on Riker's Island, in the East River, or on Barren Island, in Jamaica Bay. The Riker's Island site was the one originally recommended by Commissioner John T. Fetherston of the Department of Street Cleaning, but so strong was the opposition to it by local interests that the project had to be abandoned. Professor Whipple's report, from which the following extracts have been taken, deals

not only with the results of his own observation and study but also with the testimony of a host of expert witnesses given at numerous public hearings held recently.

THE NEW CONTRACT

On April 10, 1916, the city of New York made a new contract for the disposal of the garbage of the boroughs of Manhattan, Bronx and Brooklyn for a period of 5 years commencing Jan. 2, 1917. In asking for bids it was expressly stated that a plant operated under the contract could not locate within the boundaries of the Borough of Manhattan nor within the confines of Jamaica Bay. It is mutually agreed that at the expiration of the contract the city shall have the option of purchasing the plant and equipment of the contractor, and the land upon which the plant has been erected in the manner provided by law. The successful bidders were Gaffney, Gahagan & Van Etten, who assigned the contract to the Metropolitan By-Products Company, of which Mr. Van Etten is vice-president.

After much litigation the contractors obtained permission from the Building Department of the Borough of Richmond to erect a plant at Lake Island, on Fresh Kills, in the southwestern part of Staten Island, and the necessary buildings are now being constructed. Meantime the present proceedings were instigated.

COBWELL PROCESS OF REDUCTION

It is proposed to dispose of the garbage by reduction according to the Cobwell process, hitherto used only at New Bedford, Mass., Los Angeles, Cal., and at the Panama Exposition at San Francisco, and differing materially from the reduction methods heretofore used. Briefly, it consists in first subjecting the green garbage to the action of petroleum naphtha, or a low grade kerosene, in steam-jacketed closed containers, or digesters, capacity 3 to 5½ tons, in which the temperature is raised to from 170 to 196 deg. Fahr. In 12 to 16 minutes the boiling point is reached and then for 7 to 12 hours a process of dehydration goes on, during which the garbage is stirred by a mechanical agitator. The naphtha and water go off together and are separated in a condenser, the effluent water flowing to waste and the naphtha being saved for use. Surface condensers have been used heretofore, but it is proposed to use a jet condenser at Staten Island. During this digestion the garbage loses most of its moisture, 70 to 75 per cent by weight, becomes more or less broken up, while its grease becomes dissolved in the naphtha.

SECOND STAGE OF PROCESS

The second stage of the process consists of drawing off the naphtha-grease and washing the garbage with solvent two or three times to remove the remaining grease to an economical limit (all but about 1.5 per cent). The grease is separated from the naphtha in stills.

The third stage is the introduction of live steam to eliminate the naphtha, a process which requires from three-quarters to one and one-half hours, and a final drying by means of the steam jacket, the temperature of which may exceed 300 deg. Fahr. The solid portion of the garbage, retaining 6 to 7 per cent mois-

ture, is then removed from the containers in the form of tankage, which is subsequently sifted and ground. The active process is conducted in closed digesters, but these are necessarily opened when being filled and emptied.

NEW BEDFORD PLANT

Many witnesses testified in regard to the New Bedford plant, which comprises six digesters and has a capacity of 50 to 60 tons a day. The average quantity of garbage treated per day during the past year has been about 30 tons, but at times has run well up to the capacity of the plant. The general testimony was to the effect that since the Cobwell system was introduced in August, 1915, the plant has not produced odors sufficient to cause complaint by residents living ⅓ to ½ mile away. That the plant was not odorless was admitted by all; that the odors were much less than at plants using the older methods of reduction was also admitted. The expert testimony on the character of the effluent water was conflicting.

Evidence was presented to show that flies were very numerous at this plant, but there was no evidence to show that the flies left the plant to annoy or endanger the health of persons at a distance.

The testimony gave no indication, and certainly no proof, that the New Bedford garbage plant menaced the health of neighboring citizens, or even the health of the operatives, although some of the witnesses suggested this.

LOS ANGELES PLANT

The Cobwell system has been in operation at Los Angeles since July, 1915, but in full operation only since December, 1915. The Pacific Reduction Company, which operates it, has a 10-year contract with the city. The average quantity of garbage is about 170 tons per day, the maximum about 215 tons. The nominal capacity of the plant is about 200 tons. The only testimony introduced was to the effect that while there were some odors inside of the building, these odors were not carried more than 100 ft. beyond the limits of the grounds. The effluent water from the surface condenser flows undiluted to a private sewer and discharges over rocks to the river, which often has a dry bed. It was said to be without odor, and almost without color, and that workmen are in the habit of washing their hands in it.

In 1915 a small plant was operated in the exposition grounds. This treated a small quantity of fresh garbage apparently without nuisance. The Cobwell process was used.

EXPERT TESTIMONY ANALYZED

Professor Whipple discusses in detail the testimony of the expert witnesses and draws the following inferences therefrom:

While flies would doubtless follow the garbage to the plant and even breed at the plant, they would not leave the scows or the plant in sufficient numbers or travel such distances as to cause trouble worth serious consideration to the people of Staten Island.

Under ordinary conditions the scow loads of garbage would cause no inconvenience from odors except to persons who come relatively near to them, but under

conditions of delayed collection or of hot, moist weather the odors might carry to a greater distance and be occasionally noticed on passing boats or on the shore.

POSSIBILITY OF ODORS

It was substantially shown, says Professor Whipple, that in the past all garbage reduction plants of large capacity have given off objectionable odors; that the relatively small plants now using the Cobwell system, while not odorless, have not given off odors which have carried far; that the principal far-carrying odors in reduction plants have been due to the use of direct tankage driers, which will not be used at Staten Island; that a large plant would naturally give off more odors than a smaller plant, and that these would carry farther. Some of the experts denied this, but gave no adequate basis for their belief. It may be fairly inferred from the testimony that while under ideal conditions the plant might be kept from emitting all except local odors, yet under the best practical working conditions the chance of odors from several different sources occurring simultaneously and combining to produce an odor that would carry for a considerable distance was one that cannot be denied and should be regarded as an objection to the location. Such odors, however, would probably not extend beyond the limits of the Fresh Kill marshes and would not reach the principal settlements on the island.

EFFECT ON HEALTH

Evidence that the odors from the plant would injure the health of persons residing within their range, by affecting the appetite, causing loss of sleep and general mental discomfort, was weak and inconclusive.

Because of the noisome and unwholesome character of garbage, especially in hot weather and with delayed collection, and because of the odors likely to be given off from the plant, and because of waste products discharged into the water, it was contended that the process of manufacture should be regarded as noisome and one not suitable to be conducted near a highway or route of travel, and that operation of the plant will therefore violate the penal law. The evidence on this point was conflicting, but a fair inference, according to Professor Whipple, is that the point was well taken.

STATEN ISLAND SITE NOT BEST

On the expiration of the contract the city has the option of purchasing the plant. Should the site be a disadvantageous one from the city's standpoint, the purchase might not be made. Consequently there would be a natural tendency for the contractor to fail to keep up repairs in order to secure the greatest possible profit before the contract expired. If not purchased by the city, or the contract renewed, the plant would naturally be abandoned or used for some other purpose.

Without pretending to have made a thorough investigation of this matter, says Professor Whipple, it would appear from the evidence that the site is not the best that can be selected for the plant which will be needed by New York City in the future. It was shown by witnesses that the incineration of the garbage from the three boroughs would be impracticable because of expense. Practically all of the experts said that the

Cobwell process is the best now known. Assuming that the Cobwell system is the one best adapted to the disposal of the garbage of the city, there would be manifest economies for the city to own its own works and combine them with an incinerator for destroying the city's rubbish, in order that the heat produced by incineration might be used to furnish power for the reduction process. The experts said that a city-owned plant would be kept in a more sanitary condition than that of a private company because of not being obliged to yield to profit.

RIKER'S ISLAND SITE PREFERRED

To locate an incinerator at Fresh Kills sufficient to destroy the rubbish of New York City would be impracticable and most undesirable. Such a combined plant would be better placed on either Riker's Island or Barren Island. On the other hand, to keep such a plant as that being erected at Fresh Kills in operation for only five years would involve a heavy final depreciation and require that large profits be made during the life of the contract. To locate the Cobwell system on boats, as was suggested by some of the experts, would be impracticable.

Under these conditions it is doubtful, according to Professor Whipple, if the penalty clauses in the contract giving the Commissioner of Street Cleaning power to insist on a satisfactory manipulation of the plant would operate to prevent the creation of a nuisance.

CONCLUSIONS

As a result of the investigation Professor Whipple has reached the following conclusions:

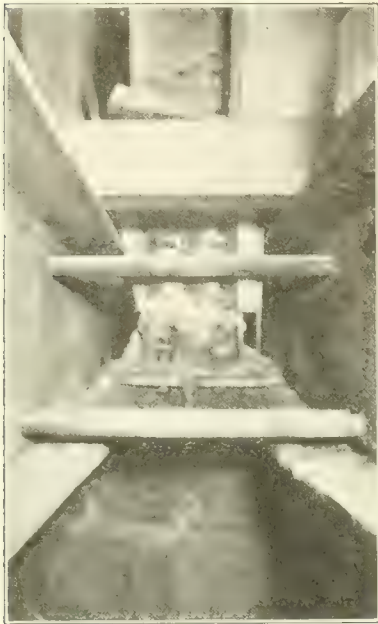
1. The transportation of garbage in scows from the boroughs of Manhattan, Bronx and Brooklyn to Fresh Kills, Staten Island, and its disposal there by the Cobwell process of reduction as proposed under the contract will not, in any appreciable or material way, affect the security of life or endanger the health of the people of Staten Island.

2. The garbage-disposal works will, by reason of odors emitted at certain times, be a nuisance (within the meaning of Section 6 of the Public Health Law and Section 1530 of the Penal Law) within the low-lying part of Staten Island which may be described as the Fresh Kill Marshes, including the village of Lino-leumville, the small settlement known as Fresh Kills and certain highways; but this nuisance will not extend generally over Staten Island.

3. The transportation of garbage in scows as provided for by the contract will under certain conditions be an offense to the residents of Staten Island along the Kill van Kull and to persons on passing boats and vessels on the Kill van Kull and Arthur Kill. Garbage and waste products will also be scattered so as to litter the banks of the Fresh Kills.

4. The Cobwell reduction process is the best method now known and available for the disposal of the garbage of the city of New York.

5. From a sanitary standpoint there are other sites in New York City more suitable and satisfactory for the location of a garbage reduction plant employing the Cobwell process than the Fresh Kills site at Staten Island, namely, either Riker's Island or Barren Island.



NEW METHODS FOR NEEDLING COLUMNS—
PLANKS KEPT WORKMEN CLEAR OF TRACKS



Build Concrete Slab Under Busy Railroad Station to Expedite Subway Construction

Long Island Railroad Underpins Flatbush Terminal Below Track Level by Constructing Heavy Slab in Sections Without Delay to Traffic

TO AVOID having its passenger platforms and tracks interfered with by construction work not directly under its control, the Long Island Railroad, under whose Flatbush Avenue terminal in Brooklyn is to be built a section of the Flatbush Avenue extension of the new subway system, has, with a special organization, built, in sections, a reinforced-concrete slab beneath its tracks and column footings for the entire length of the proposed subway within its building lines. It has also underpinned all columns liable to be affected by the subway construction. This slab will form a stiff, solid roof for the subway excavation, and will make it safe to mine under the station through the glacial drift, on which it is founded, by ordinary methods. It will also obviate extremely complicated and expensive shoring which would have been required without this preliminary work.

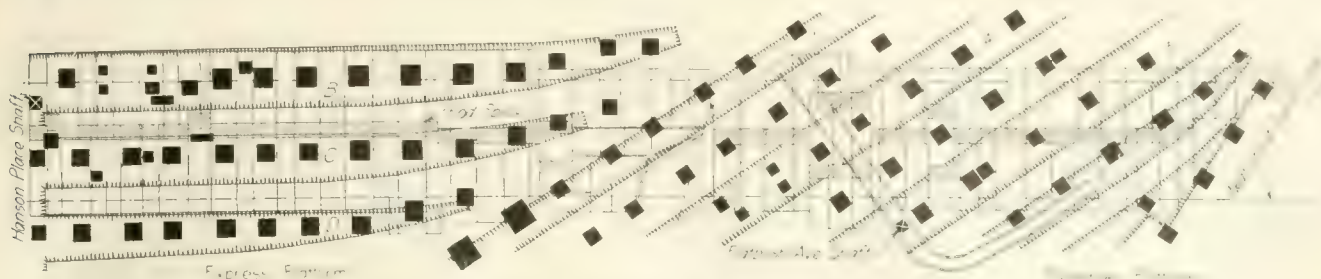
The earthfill within the sections of the old passenger and express platforms affected was taken out in railway cars. Shafts were sunk from Hanson Place and Flatbush Avenue, and drifts were driven beneath the tracks to give access to the excavation for the slab, which proceeded by sections and was disposed of by team or by backfilling the rebuilt platforms. Concrete was mixed at street level and spouted down to buggies on the platforms for distribution. The entire work was completed in the eight and one-half months between Feb. 17 and Oct. 31 last, without a single accident resulting in disability, and without injury to a single passenger. The time required, while two and one-half months longer than was at first planned, is considered remarkably short in view of the size and difficulty of the work, of the fact that extra work ordered greatly increased the num-

ber of columns to be shored, and in view of serious delays from strikes and other causes.

The Flatbush Avenue terminal has three levels, the street floor being occupied by the freight house, above which, on an upper level, are the freight tracks. Below the freight house, underground, is the passenger and express station. The concrete slab built occupies a strip beneath this lower level approximately 65 ft. wide by 500 ft. long. The slab will be required to carry directly and permanently the loads from all the columns within its area. As may be seen from the accompanying plan, the slab crosses the passenger tracks along a skew, and practically all the columns within its limits are staggered with reference to its center line. Both on this account, and because of its width, it was not possible to excavate and concrete strips clear across it, and it was therefore decided to excavate strips half width and splice the slab in the center for most of its length.

WORK DONE BY SECTIONS

Proceeding in this way, it was possible to excavate and concrete two strips on each side of a column, needle the column from them, and then excavate and concrete the strip beneath the column. The sections taken out in this way were from 150 to 400 sq. ft. in area. The splice at the middle of the slab was made between adjoining sections by lapping the reinforcing 6 ft. and concreting the lap with the second section placed. Fifty-eight column footings, the possible future loads on which range from 200 to 500 tons, are carried directly by the slab. In addition to these, 23 other columns the footings of which might be undermined by the subway



COLUMNS STAGGERED WITH REFERENCE TO SLAB NECESSITATED CENTER SPLICE

construction were underpinned. The subway structure to be built beneath this slab includes two tracks and an island station platform, and is approximately 48 ft. wide between neat lines.

OLD PLATFORMS REPLACED FIRST

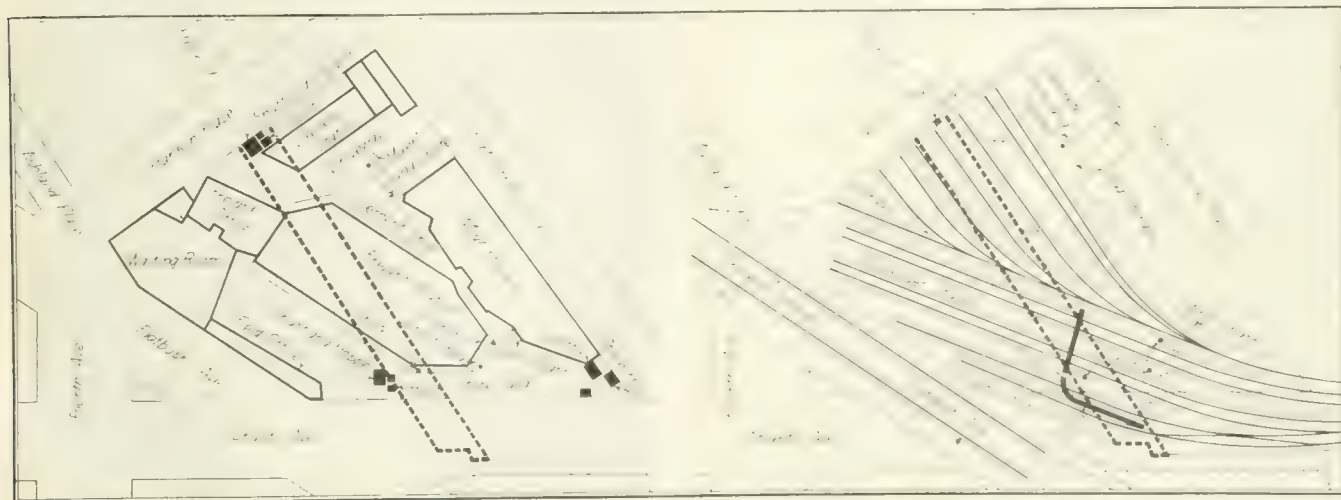
The old platforms in the Long Island station consisted of concrete side walls and a concrete deck, the space beneath which had been backfilled. The first work done was to cut out this concrete, replacing it with temporary wooden platforms, and load the spoil, together with the old backfill, into gondola cars which were run in on the Long Island tracks at night. After this had been done it was possible to operate small swivel dump cars on narrow-gage tracks beneath the platforms, and dispose of the remaining excavation without interfering with train operation. Work under platforms B, C and D, which were used only by the Adams Express Company, was simplified by handling part of the dirt up to the platform level and wheeling it along the platform in buggies. In this way, after the slab sections underneath platforms C and D had been concreted, and the platforms partly restored, they were backfilled with material taken from the slab sections under platform B.

Altogether, it was possible to arrange the work so that 4030 yd. of the excavated material was utilized as backfill. The passenger platforms, however, could not be rebuilt in this way without causing too great inconvenience to the patrons of the railroad, and they were consequently restored by building cross-walls to support the reinforced-concrete deck. Altogether, 11,760 cu. yd. of sand, boulders and gravel were excavated, of which 2200 yd. were disposed of in railway cars at the beginning of operations, leaving 5530 yd. to be taken out at the shafts and disposed of by team.

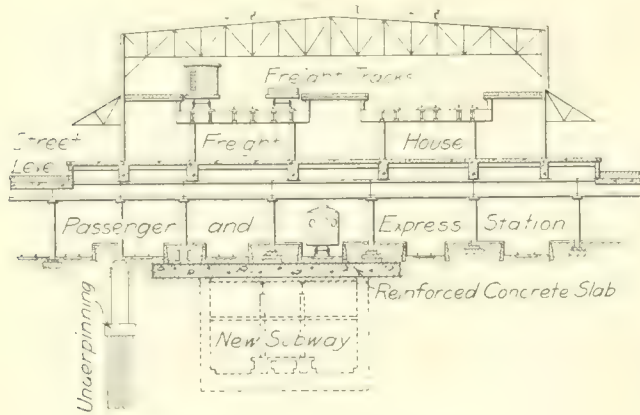
A great many boulders and a considerable yardage of hardpan were encountered in the excavation, most of this material being under the passenger platforms. As it was not possible to use explosives, the boulders and hardpan had to be drilled with air hammers and split apart with plugs and feathers. The old concrete platforms were also removed in the same way. The railway tracks were supported across the sections being excavated, and across the drifts dug to gain access to the narrow-gage tracks under the platforms, by I-beams. The blocking was left in place under the tracks until the slab had been practically completed. It was then removed and the ballast replaced and tamped under the ties.

NEEDLING COLUMNS DIFFICULT

The columns rested on cast-iron bases and concrete pedestals, the bottoms of most of the footings being less than 2 ft. above the elevation of the top of the slab. It was found economical to save most of the old pedestals, but there was not sufficient headroom to insert beneath them needles capable of supporting the entire load. They were therefore held by placing 10-in. I-beams beneath them, the direct load of the column above being carried on 24-in. or 30-in. I-beams. To avoid the slow and expensive work of cutting out rivets and bolting brackets to the columns, a slot was chipped out under the cast base at each side, and the I-beams were set with their lower flanges under the base, the slope of the flange being compensated by inserting wedge-shaped steel fillers. The beams were then clamped around the column by six 2-in. diameter bolts, four at the bottom and two at the top. After these were drawn tight the space between the beams around the column base was filled with concrete. With a few of



PLANT LAYOUT ADAPTED TO STREET AND TRACK LEVEL WITH LEAST INTERFERENCE WITH TRAFFIC



SLAB SPANS CUT FOR NEW SUBWAY

the smaller columns, similar to the one shown in the photograph, the concrete filling was omitted and the needles wedged away from the column with wood.

At points between the tracks, I-beam grillages were required. One of the photographs shows a column where the clearance was so small that the bracket plates had to be bent to permit trains to pass.

The columns underpinned outside the slab were carried by beams bearing on cribbing on temporary blocks of concrete constructed for the purpose. Pits were sunk underneath the columns, within which 14-in. pipe piles were driven with drop hammers to an elevation 5 ft. below the bottom of the proposed subway. From three to eight piles were used under each column, according to the load to be carried. As the piles were difficult to drive in the compact sand and gravel after a penetration of 16 ft. had been reached, the pits were generally sunk as deep as circumstances permitted. After driving, the pipe casings were cleaned out with a small orange-peel bucket to within a few inches of the bottom and filled with concrete. Tests of these piles indicated a safe loading value of 35 tons per pile.

CONCRETING CARRIED ON AT NIGHT

The portable concrete mixer used was set up at various points over the platforms below, inside the freight yard of the Long Island Railroad. The team platform outside the freight house covers a vault space inclosed by a vertical partition under the edge of the platform. By breaking through this partition at three points it was possible to hang vertical chutes, through which the mixer could discharge directly into hoppers supplying buggies on the platforms below. To reduce interference with passenger traffic, practically all the concrete work under these platforms was carried on at night.

The other concrete plant, located over the north end of the express tracks, could be run during the day. The mixer did not have to be moved, as an end platform underground across the north side of the station connected the express platforms over the slab. This plant, as shown on the layout drawing, was located near the muck shaft used for this half of the work.

The slab reinforcing is made of square bars top and bottom, varying from $1\frac{1}{8}$ to $1\frac{5}{8}$ in., and of $\frac{5}{8}$ -in. square double diagonal shear bars spaced from 12 to 36 in. apart. As it would have been difficult to set the steel accurately according to the first design, this was modi-

fied so that each set of shear bars could be tied top and bottom to a pair of the heavy horizontal bars, thus making it possible to assemble all the reinforcing in panel units the length of the section being concreted. The reinforcing was assembled in this way in the pits, tied with 16-gage annealed wire, and stood up with the proper spacing on 2 x 4-in. strips stood on edge across the section being constructed.

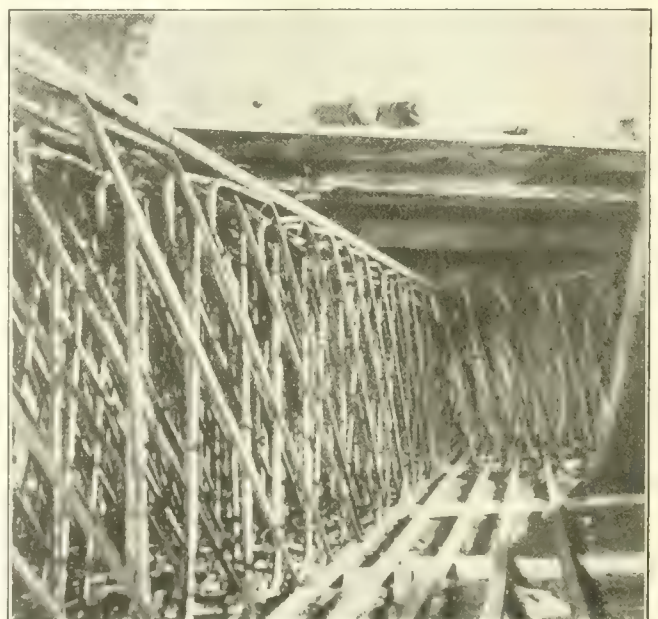
THIRD RAILS BOXED IN

Great precautions were taken in building the temporary wood platforms to box in the track space to prevent the workmen from getting their arms or tools in the way of trains. The spaces between and outside the rails were floored, and strips of wide plank were nailed to the posts supporting the platforms. The third rails were entirely boxed in, except for a narrow slot on the inside to accommodate the contact shoes on the trains.

The labor cost for excavation averaged \$5.70 per cubic yard, but this includes the removal without blasting of old concrete, the excavation from the underpinning pits, much of which had to be rehandled several times, the work of ballasting and maintaining tracks, and the sheeting of the trench excavation. This sheeting, of course, served as concrete forms. The labor charge for excavation, therefore, is approximately subdivided as follows:

	Quantity, cu. yd.	Unit labor cost	Total labor cost
Platform and slab excavation...	9,520	\$3.83	\$36,472
Pit excavation	940	6.20	5,828
Concrete removal	1,300	15.00	19,500
Sundry labor, ballasting, etc.		...	6,000
Total	11,760	5.70	67,800

The above unit costs represent only the labor charges on account of the special organization which carried out the work. The excavation cost in the accompanying table, however, also includes, besides its share of the overhead, all labor charged to the work on account of bridging, track, signal, and all other items of work performed by regular forces of the Long Island Rail-



REINFORCING BUILT UP IN PANELS

road. All the unit costs in this table include insurance, supplies, materials, labor, and an allowance for plant, power and water, in addition to office expense, salaries, and other overhead chargeable to the work, both on

COMPLETE UNIT COSTS		
Work	Quantity	Unit cost
Excavation	11,760 cu. yd.	\$10.60
Slab concrete	4,720 cu. yd.	7.21
Platform replacement concrete	1,130 cu. yd.	20.50
Slab reinforcement	620 tons	58.60
Piling	3,796 lin. ft.	3.28
Temporary support of columns	81 columns	204.80

account of the Long Island Railroad and of the special organization in charge of the work.

The work was carried on under an agreement between the Long Island Railroad Company and the Public Service Commission. The design was undertaken by the engineering force of the Public Service Commission, while the actual work was carried out by a special organization formed by the Long Island Railroad Company under the direction of James Forgie as consulting and construction engineer. J. R. Savage, chief engineer of the Long Island Railroad Company, acted as supervising member of the railroad's committee of three in charge of the protection of the terminal. S. V. Morris and C. L. Addison were the other members of the committee. The Public Service Commission was represented on the work by John H. Madden, assistant division engineer.

Flat-Slab-Design Formulas Proposed by Joint Committee

Final Report of Committee on Concrete and Reinforced Concrete Contains Rules Based on Empirical Treatment

AMONG the important features of the new section on the design of flat slabs just published in the final report of the Joint Committee on Concrete and Reinforced Concrete, on page 1691 of the December issue of the *Proceedings* of the American Society of Civil Engineers, are formulas for thickness in terms of loading and panel length, formulas for bending moment, new assumptions regarding the variation in stress across the sections considered, requirements for distribution of steel reinforcement and the increases prescribed for bending moments at wall panels and columns next to the walls. The following abstract of the report covers these essential features of the new section and the principal changes made since the progress report of 1912, so generally used, was published in the *Transactions* of 1914, Volume 77, page 385.

The general recommendations made by the committee relate to flat slabs extending over several rows of panels in each direction, and it is stated that necessarily the treatment is more or less empirical. The coefficients and moments are given for uniformly distributed loads.

The diameter of the column capital is to be measured where its vertical thickness is at least $1\frac{1}{2}$ in., provided the slope below this point is not more than 45 deg. with the vertical. It is recommended that the diameter of the column capital generally be made not less than one-fifth of the panel length. For special loading, variations

in panel length, etc., the column capital must be designed and reinforced for compressive stresses and to give rigidity of connection to the floor slab.

The thickness and width of dropped panel may be governed by the required resistance to compressive or shearing stresses. It is recommended, however, that the width should be at least four-tenths of the corresponding panel length between centers of columns, and that the offset in thickness be not over one-half of the thickness of the floor slab.

FORMULAS FOR SLAB THICKNESS

While resistance to bending and shearing forces largely governs the thickness of the floor slab, or resistance to deflection may control in the case of large panels with light loads, it is recommended that no slab less than 6 in. thick should be used, or less than one-thirty-second of the panel length for floor slabs or one-fortieth of the panel length for roof slabs. The following formulas for minimum thickness t , in terms of the panel length L in feet and the sum w of the live load and dead load in pounds per square foot, are proposed.

For slabs without dropped panels

$$t = 0.024L\sqrt{w} + 1\frac{1}{2}$$

For slabs with dropped panels

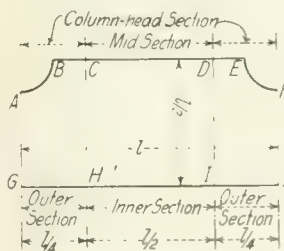
$$t = 0.02L\sqrt{w} + 1$$

For dropped panels whose width is four-tenths of the panel length

$$t = 0.03L\sqrt{w} + 1\frac{1}{2}$$

BENDING AND RESISTING MOMENTS

Adopting the analysis by J. R. Nichols in the *Transactions*, Volume 77, page 1670, the report gives the following equation for the numerical sum of the positive moment and the negative moment in vertical sections taken midway between columns and along an edge of the panel parallel to the first section, but skirting the periphery of the column capitals at the corners, as in the diagram:



$$M = \frac{wl}{8} \left(l - \frac{2}{3}c \right)^2$$

in which l is the side of a square panel between centers of columns, c is the diameter of the column capital and w the total load per square foot as before. For an oblong panel there are given corresponding formulas for the sums of moments in the directions parallel to each side.

The proportion of this total resistance M which exists as positive moment or as negative moment is said to be not readily determined, and depends upon the design of the slab; but it is stated that it seems proper to make the division of total resisting moment in the ratio of three-eighths for the positive moment and five-eighths for the negative moment.

As the law of distribution of the resisting moment across the sections considered is not known definitely, it is proposed that certain empirical assumptions be

made. It is considered sufficiently accurate, in general, to divide the sections into two parts and use an average value over each part. Recognizing the effect of tension in the concrete which acts to decrease the intensity of the compressive stress, and using the assumptions given in the report and usual working stress values, the following moment coefficients are recommended, which are somewhat less than those derived by analysis:

For a square interior panel, the total positive moment for a section in the middle of a panel extending across the width may be taken as

$$\frac{wl}{25} \left(l - \frac{2}{3} c \right)^2$$

Of this moment, at least 25 per cent should be provided for in the inner section $l/2$ in width, as shown on the diagram, and in the two outer sections at least 55 per cent for slabs not having dropped panels, except that in determining the necessary slab thickness at least 70 per cent should be used for the two outer sections.

For a square interior panel, the total negative moment for a section connecting column capitals as shown in the diagram and forming the projected width of the panel may be taken as

$$\frac{wl}{15} \left(l - \frac{2}{3} c \right)^2$$

Of this negative moment, at least 20 per cent should be provided for in the mid-section and at least 65 per cent in the two column-head sections, except that for dropped panels 80 per cent should be used for the two column-head sections.

MOMENTS FOR OBLONG AND WALL PANELS

When the length of a panel does not exceed the breadth by more than 5 per cent, the computation may be made as for a square panel of side equal to the mean of the two dimensions. When the length is between one-twentieth and one-third greater than the breadth, formulas for total positive and negative moments corresponding to those for oblong panels are given, and the apportionment to the various parts of these sections may be made as for the square panel.

For wall panels, the coefficient for total negative moment in the first row of columns away from the wall should be increased 20 per cent over the foregoing values, and likewise the coefficient for total positive moment in the section half way to the wall should be increased 20 per cent. For negative moments at the wall, the relative stiffness of columns and slab and the conditions of restraint should be considered, but in no case should this coefficient be less than one-half that for interior panels.

To make computations for other sections, it is recommended that the point of inflection on any line parallel to a panel edge be taken as one-fifth of the clear distance between the two opposite sections of negative moment, as already considered (see diagram), except that for dropped panels this coefficient should be taken as one-fourth.

It is recommended that all bars be designed to extend twenty diameters beyond the point of inflection or else hooked or anchored at that point; in addition, bars in diagonal bands used for negative resisting moment

should extend 0.35 of the panel length across the column center, and those used for positive resisting moment should extend 0.35 of the panel length on each side of a diagonal through the center of the panel. No splices by lapping should be permitted at or near regions of maximum stress, except as just described.

It is recommended that not more than one-third of the bars in any direction be made shorter than the distance between centers of columns in that direction. Bars should not all be bent up at the same point, but the zone of this bending should extend on each side of the assumed point of inflection and should cover a width at least one-fifteenth of the panel length. In the calculations, all bars which cross the section considered and fulfill the foregoing requirements may be used. In the case of four-way reinforcement, the area of diagonal bars should be multiplied by the sine of the angle between the bars and the straight part of the section considered.

At construction joints, it is recommended that extra bars equal in section to 20 per cent of the amount required to resist moment be added, to extend at least 50 diameters beyond the joint on each side.

STRESS ANALYSIS

Usual methods for calculating internal stresses are to be used; in the case of the dropped panel, the section of the slab and dropped panel may be considered to act integrally for a width equal to the width of the column-head section. In calculating shearing stresses for diagonal tension at the column-head sections, the total vertical shear on two such sections shall be considered as one-fourth of the total dead and live loads on a panel for a slab of uniform thickness, and three-tenths of this total for a slab with dropped panels. In calculating the punching shear, uniform distribution may be assumed around the periphery of the column capital, provided the total vertical shear be increased by 25 per cent.

Girders or beams should be provided to carry walls or concentrated loads in excess of the capacity of the slab, and also in case openings in the floor reduce the working strength below the required capacity. Special analysis should be made for structures having a width of only one, two or three panels. It is recommended that provision be made in both wall columns and interior columns for the bending moment developed by unequally loaded panels, eccentric loading or uneven spacing of columns. The amounts of these moments should be found by rational methods, using the principle of least work or of slope and deflection. Generally, the larger part of the unequalized negative moment should be considered as resisted by the columns and special attention should be given to wall columns and corner columns.

OTHER IMPORTANT CHANGES

Among the most important of the details in which the final report differs from the preceding progress report are the following:

Blast-furnace slag as aggregate for concrete, especially reinforced concrete, is not recommended, in the absence of satisfactory specifications or methods of inspection to control its uniformity and insure durability. Cinder concrete should not be used for rein-

forced-concrete structures except for floor slabs not exceeding 8-ft. span.

The specifications for steel reinforcement are changed to those for billet steel concrete reinforcement bars of the American Society for Testing Materials.

In specifying the minimum time required for machine mixing, the old value of 1 minute is changed to 1½ minutes, and for mixers over 2 cu. yd. capacity is made 2 minutes. It is stated that a longer time is preferable and that mixers should have a locking device to prevent discharge within the minimum time, and means should be provided to prevent aggregates being added after mixing has commenced. Various desirable additions to mixer equipment and a uniform speed at periphery of drum of 200 ft. per minute are recommended. It is stated that the quantity of water is of the greatest importance—too much is as objectionable as too little.

New paragraphs and recommendations affect reinforced-concrete design. Continuous beams built monolithically into supports may be considered of span length equal to the clear distance between supports, also when the bottom at the ends makes an angle not more than 15 deg. with the axis of the beam. Brackets may be considered to reduce the clear span when they make an angle of 45 deg. or more with the axis. The span can then be taken between sections where the combined depth of beam and bracket is at least one-third more than the depth of beam.

The effective width requirements for T-beams are changed to make the overhanging width on either side of this web not to exceed six times the slab thickness, instead of four times.

FLOOR SLABS AND CONTINUOUS BEAMS

In designing square floor slabs supported along four sides, one-half the live and dead load moment may be used as the moment resisted in each direction. For oblong slabs (length l not over one and a half times the width b) the moment for transverse reinforcement may be taken by using a proportion of the live and dead loads given by the formula

$$r = l/b - 0.5$$

Account may be taken of the fact that the bending moment is greater near the center of the slab by placing sufficient reinforcement in the center half of the slab to carry two-thirds of the total moment and in the two outside quarters to carry one-third.

At the ends of continuous beams, in ordinary cases, a negative moment of $wl^2/16$ may be taken; for small beams and heavy columns this should be increased, but not to exceed $wl^2/12$. New paragraphs suggest that for continuous-beam construction it is important that ample foundations be provided to prevent the unsightly cracks produced by unequal settlement, more likely to occur in low structures. Wall girders should be designed to resist torsional moment arising from negative moment at the ends of the beams framing into them.

Several new and revised requirements in the section on web reinforcement are given, more or less empirical methods being employed.

The recommendations in the section on columns with longitudinal reinforcement contain a new requirement for lateral ties not less than ¼ in. diameter not exceed-

ing 12 in. apart, nor more than 16 diameters of the longitudinal bar. The minimum size of column to which the specified working stresses may be applied is made 12 in. out to out. Hooping or spiral steel must be made at least 1 per cent of the volume of the concrete in allowing 55 per cent higher unit stress for such columns, and the upper limit for ratio of unsupported length to diameter is changed from 8 to 10. The committee has no recommendation to make for columns longer than 10 diameters.

NEW PARAGRAPH ON CONCRETE SHRINKAGE

A new paragraph on the tendency of concrete to shrink and the necessity for reinforcement thoroughly to connect together the component parts of floor and wall members, in some proportion to the size of the members, is added.

Finally, a few changes are made in the section on working stresses—the required values for compressive strength are given for proportions 1:3, 1:4½, etc., in terms of combined volume of fine and coarse aggregates measured separately, instead of 1:1:2, 1:1½:3, etc., as in the previous report. Compression for bearing surfaces is increased from 32.5 to 35 per cent of the compressive strength. Axial compression values given are limited to plain concrete piers the length of which does not exceed four diameters. Changes are made in the section on shear and diagonal tension and new explanations added regarding web reinforcement. Bond stress for the best types of deformed bar may be increased, but must not exceed 5 per cent of the compressive strength of the concrete. For modulus of elasticity a new ratio of one-fortieth that of steel when the strength of the concrete is less than 800 lb. per square inch is added.

It is stated that twenty-one members of the committee have taken a more or less active part in the preparation of the final report and all members (twenty-eight) have agreed to it in its present form. Edward Godfrey dissents from the portion relating to stirrups and to rodded columns, and presents an alternate treatment. The committee, composed of representatives from the American Society of Civil Engineers, the American Society for Testing Materials, the American Railway Engineering Association, the Portland Cement Association, and the American Concrete Institute, acknowledges its indebtedness to Prof. A. N. Talbot, Prof. W. K. Hatt and Prof. F. E. Turneure, the subcommittee on design, for their invaluable and devoted service. J. R. Worcester is chairman and R. L. Humphrey is secretary of the Joint Committee.

Error in Equation for Velocity of Pressure Wave Through Pipe Lines

In the article by Barton M. Jones on pipe design based upon water-hammer pressure an error in the original copy was made in the equation for velocity of pressure wave through the pipe. This equation for velocity v , given at the bottom of the first column on page 795 of the issue of Dec. 30, 1916, should be changed to read

$$47,200$$

$$v = \frac{d}{t} \cdot 102$$

Results Given for Field Tests of Reinforced-Concrete Pipe

Diameters for Storm-Water Sewer at Winnetka, Illinois, Varied from 24 to 36 Inches—Applied Load Proportioned to Pipe Diameter

By J. T. CHILD
Winnetka, Ill.

FIELD tests of circular reinforced-concrete pipe from 24 to 36 in. in diameter, laid last fall as a storm-water sewer in Winnetka, Ill., gave results shown in the accompanying table. In making the tests it was specified that both the load and the pipe itself should



SACKS OF SAND OR CEMENT FURNISHED LOAD FOR FIELD TESTS

have a bearing over one-sixth of the circumference of the pipe. The test pipe was required to sustain without failure a load in pounds per linear foot equal to the inside diameter of the pipe in feet times the factor 1000.

The tests were made by piling full sacks of cement or sand on a wooden platform made to fit the curve of the pipe. A depression in the ground made the

required bearing surface for the pipe. These conditions approached as nearly as possible the actual conditions the pipes are subjected to and made testing easy. All the concrete pipes on the job were circular, with the wire-mesh reinforcement placed concentrically. They were made by the Reinforced Concrete Pipe Company, of Chicago.

The cracks which developed were hair cracks in all cases and did not extend the entire length of the pipe. They were in no sense pipe failures. The cracks disappeared when the loads were removed from the pipes. After Nov. 1, the water and sand used for making the concrete was heated, and salamanders were used inside the pipe until setting had taken place. Fourteen days were specified as the time for curing the concrete. The inadvisability of laying green pipe is shown in the tests on 33-in. pipe only 11 days old.

An additional storm water sewer is planned for Winnetka for next year which will amount to over \$60,000. The pipe from 24 in. up to 51 in. will be of reinforced concrete.

Orders New Basis of Rates for Fire Protection

Illinois Utility Commission Stipulates Rental per Foot of Main Extension In Addition to Flat Rate per Hydrant

FIRE PROTECTION for municipalities, where the waterworks are under private ownership, is commonly charged for at a uniform rate per hydrant. A departure from this plan is ordered by the State Public Utilities Commission of Illinois in a decision recently made in the rate case of the city of Lincoln versus the Lincoln Water & Light Company, Commissioner Walter A. Shaw writing the opinion. The plan stipulated by the commission was proposed by Dabney H. Maury, consulting engineer, of Chicago, one of several engineers called into the case at different times to appraise the property. The rates prescribed in the opinion are \$8,900 per annum for the service as of the date of valuation (Nov. 1, 1914), \$5 per year rental for each new hydrant, and the following rates per year per foot of main extensions of various sizes: 4-in., 5 cents; 6-in., 6 cents; 8-in., 8 cents; 10-in., 11 cents, and 12-in., 14 cents. The new schedule recognizes that the cost of hydrants is only a small part of the total cost of service, and that to impose the whole burden on the hydrants is to tempt the municipality to get along with inadequate fire protection.

Wear of Wood-Block Paving in Minneapolis

An official inspection of wood-block pavement laid in Minneapolis during 1906 shows that in only two out of thirteen sections were more than 5 per cent of the block depressed as much as $\frac{1}{2}$ in. below the general level of the street. The two exceptions were in the heaviest traffic districts of the city, and one of them showed 13.5 per cent of the block depressed as compared with 16.5 per cent in the other section. Those sections of pavement made with longleaf pine and birch showed only 2 per cent of the blocks depressed after 10 years' service.

FIELD TESTS ON REINFORCED-CONCRETE PIPES

Size, inches	Age, days	Required load inches $\times$ 1000 lb.	Load applied, pounds	Remarks
36	20	12,000	12,000	No cracks.
36	11	11,000	11,000	One crack in bottom.
33	11	11,000	12,625	Pipe too green. Two cracks at top 1 ft. apart; one at bottom; pipe too green for laying.
33	26	11,000	11,000	Crack in sandy seam.
33	10	11,000	11,000	No cracks.
33	9	11,000	11,000	No cracks; warm water used in mix- ing in November.
30	20	10,000	10,450	No cracks.
24	20	8,000	8,000	No cracks.
24	11	8,000	8,000	No cracks; cold weather Nov. 10 to Dec. 11.

American Society's Valuation Committee Presents 230-Page Report

**Depreciation Section Revised to Differentiate Between Classes of Utility
—All Real Land Costs Should Be Allowed, But No "Higher-Use" Value**

COMPLETE revision of the section on depreciation, objected to so strenuously by the membership of the American Society of Civil Engineers when its special valuation committee rendered its first report three years ago, is one of the features of the new report just presented by the committee. As to whether or not depreciation should be deducted in rate cases, distinction is now made according to methods of depreciation accounting and the character of regulation that have prevailed. Only where provision is made in the rate, or should be in the accounting, for an accumulating fund is a deduction advocated for loss of service life, and this the committee would offset by the fund so long as it has not been returned to the owners of the utility. The theory makes railroads exempt from deductions. The equal-annual-payment method for computing depreciation is still favored, but is now called the compound-interest method. That estimated original cost is not dependable; that original topographic conditions but present-day prices and methods should govern in estimating reproduction cost; that all real items of cost but no "higher-use" value should enter into the reproduction cost of land, and that development expense and going value are distinct—the one tangible, the other intangible—are among the numerous other noteworthy findings of the committee.

The report of the committee is published in the December *Proceedings* of the society, beginning on page 1709. It contains 230 pages. Of these, 211 pages constitute the report proper, which is preceded by an abstract that in itself contains 12 pages. The committee states that in the five years since its appointment forty-eight joint meetings have been held and a correspondence aggregating thirteen substantial volumes has been carried on. The report is signed by the present members, Frederick P. Stearns, chairman; Leonard Metcalf, secretary, and William G. Raymond, Jonathan P. Snow, Charles S. Churchill, Henry E. Riggs and William J. Wilgus. The latter three were appointed in 1914 to fill the vacancies caused by the deaths of Thomas H. Johnson and Alfred Noble and the resignation of Henry M. Bylesby.

The committee's abstract, slightly condensed, follows:

GUIDING BELIEFS OF COMMITTEE

The committee, in its consideration of the subject assigned to it, has been guided by the belief that stress should be laid on fundamental principles and general methods rather than on details which necessarily vary under different circumstances; that the discussions, unless otherwise stated, should be confined to normal properties; that valuation should have its foundation in fact; that where there are alternative methods equally fair to the parties affected, the one should be selected which is most capable of being carried out effectively under present laws, as defined by the courts, and which is most desirable for general use in the direc-

tion of uniformity; that recognition should be given to the interdependence of the various elements which enter into the problem; that while major attention should be given to the ascertainment of the cost of creating the property in question and its business, due consideration should be given to intangible values, and that the important item of interest, in this report meaning interest compounded annually, should always be considered.

In the light of this preliminary understanding and of the discussions which ensued, the following conclusions have been reached:

Fundamental Principles of Valuation

The principles and methods must be such that when properly applied the result will be fair to all parties affected and of a nature that will attract to the service of the public capital necessary for building new properties and for improving and extending old ones.

New Properties—In the valuation of a new property, if the question of a fair return is at stake, the actual investment in the portion devoted to public use, including working capital and development expense, should be taken as the basis for "fair value"; if the same property is to be valued for public acquisition, the basis of "fair value" should be the actual cost, including the money value of services and other considerations involved; if the valuation is to be used for capitalization, the result should be attained in the same way as the return base, except that all parts of the property should be included; and if for taxation, whether of a new or old property, the result must accord with the laws of the state, or, where not governed by such laws, should be fixed at a sum consistent with the valuation of other property for taxation.

Old Properties Under Continuous Regulation—In the valuation of an old property, operating without competition and from its inception under commission control as to rates and methods of accounting, and assumed to have been entitled to earn sums sufficiently large to provide for all expenses of maintenance, operation and taxation, depreciation allowances and a fair return on the "fair value" of the property, the owner should be compensated in some way for losses sustained during the early years of operation before the property was tuned up and the business developed, either by including in the valuation the sum of the deficiency of earnings in the early years, with interest, or by allowing higher rates of return in subsequent years to offset the early deficiency.

Old Properties Not Under Continuous Regulation—In the valuation of an old property which has not been subject to continuous regulation, not only are the foregoing principles important, but there are many cases in which equity calls for the inclusion of not only the sum representing the sacrifice by the owner but also a further positive or negative sum representing valuable property or rights acquired or lost by the owner as a

result of time or through the failure of the public or the owner to assert his authority, the courts holding that the present value of the property should be used rather than its cost.

Physical Property to Be Included

The physical property to be included varies in different cases with the use to which the valuation is to be put and the law governing the case.

Used and Unused Property—In cases of rate regulation, only the property considered devoted to public use should be included, embracing that in active use and also that properly and reasonably held in reserve to insure the safety, economy, sufficiency and continuity of service. In valuations for capitalization and public acquisition all of the property in question should be included.

Retired or Discarded Property—Plant units definitely abandoned and not likely again to be used, due to having been worn out in service or by reason of the reconstruction of the property, should be excluded from the valuation and should appear either in a separate schedule of retired or discarded property, or such full statement of the conditions should be made as will definitely fix the status of the units or parts. Temporary works necessarily built in connection with, or required for, the construction of permanent works, or for furnishing service to the public at an earlier date than it could be furnished by the permanent works, should be included in the valuation.

Excessive Size or Capacity—No reduction should be made in the valuation on account of excessive size or capacity, except when the excess is so great as to be clearly unreasonable and is the result of not using proper foresight.

Donated Property—Lands or other property voluntarily donated to a public utility should be included when determining the reproduction cost, on the same basis as land and property otherwise acquired.

Leased Property—In the case of leased property, either the property itself or the lease should be valued, as circumstances may dictate.

Title to Property Not Conclusive—Structures located on land to which the owner of a public utility has no title should be included in the valuation of the property where the owner has been required by law or necessity to pay their cost, including in this class also property voluntarily donated; and they should be excluded where other public-service companies, the public or the users, other than the owner in question, have been required to pay their cost.

Working Capital—It is customary to include under the term "working capital" the amount of cash, materials and supplies provided for use in the plant, but not yet forming a part of it, and other current assets essential for proper maintenance, operation and administration. There should be included an amount of working capital sufficiently large not only to meet the usual requirements, but to provide for emergencies.

Securities Owned—Ordinarily, the valuation of property devoted to public use should not include securities owned, or surplus cash not forming a part of working capital, except in instances where such securities and surplus cash are an offset, in whole or in part, for depreciation deducted from the cost of the property.

Original Cost to Date

As defined by the committee, original cost to date is the first cost of the identical property units now in use, including overhead charges.

Difficulties—While much of the difficulty of determining original cost as thus defined in some cases may be removed, especially in the case of short-lived property, it is not feasible to obtain a dependable result where the absence of reliable historic data makes necessary a resort to estimates, as in the case of old properties consisting mainly of long-lived items.

Schedule—Generally it will be found necessary to prepare a schedule in the same way that one would be made for determining the cost of reproduction, many adjustments in the records often being required, even under the most favorable conditions, in order to obtain correct results.

Costs—Unit Costs—When a schedule is necessary, the corresponding costs or unit costs are essential to the completion of the inventory, and where these are unobtainable, as is usually true in the case of property units acquired or created long ago, the ascertainment of the original cost is impossible.

Overhead Charges—Overhead charges are, as a rule, inadequately reflected in the records, and therefore adjustments are required which are largely matters of opinion and speculation, and which, in consequence, make more uncertain the final result, thus often destroying its usefulness.

Development Expense—The expense actually incurred in connection with the tuning up and creation of the business of a property should be included as a part of the original cost to date.

Cost of Reproduction

Theory of Reproduction—Estimates of the cost of reproduction should be based on the assumption that the identical property is to be reproduced, rather than a substitute property; that while apparent present-day conditions that would affect the cost of reproducing the property must be considered in any logical estimate, yet history must also be considered to determine what is to be reproduced, the conditions under which it is to be reproduced, and how the estimates must be made; that for all those items concerning which there can be no doubt the engineer should use the basis plainly applying, and that for those that are doubtful, or have been questioned, he should present the effect of the use of the different bases clearly, that the determining body may have the data for a wise decision; and that normal present conditions shall determine the prices and methods for doing the work.

Preliminary Work—The first step in estimating reproduction cost is such a study of the property and its history as will enable the estimator to make a complete list of all items, lay out a proper financial and construction program, and fix proper unit prices to the several items of the schedule, after which the property should be divided into groups of items or units which will lend themselves to the depreciation study and accounting, preferably following some well established classification of accounts.

The field schedules and inventories, suitably recorded on appropriate forms, should not only be based on full

and complete surveys and inspections of the visible physical property, but should also reflect a careful historical search of existing records of original conditions and other reliable sources of information bearing on items of material or work which entered into or were incidental to actual existing units, special care being exercised to exclude that not capable of definite proof, and to limit the speculative uncertainties as far as possible.

Unit Prices—In determining unit prices a rational sequence of construction should be assumed, and rational assumptions made as to the manner of doing the different parts of the work, whether by company forces or by contract. Unit prices based where possible on the actual cost of doing similar work, in a similar manner, under similar circumstances, should be determined by persons of experience and sound judgment. They should be based on the normal average cost of work for a considerable period—say, 5 or 10 years. In the case of items which are steadily increasing or decreasing in value, the prices adopted should be normal for the time of the valuation. Full consideration should be given to the time allowed for construction, to climatic conditions and to the effect of any other significant conditions or limitations upon the cost of the work.

REPRODUCTION COST OF LAND

Separate parcels of land, such as one or two lots, or a tract of not unusual size, not connected with other lands of the utility in a strip or body, and where freedom of choice in selection may be exercised, should be valued on the same basis as other lands in the vicinity used for general purposes.

Where large tracts have been acquired, made up of a number of separate entire parcels, the history of the transaction should be completely investigated and allowance made in the estimate for costs of vacation of streets, or acquisition of other rights, incident to the use of the property as a whole. Such further allowances should be made as may seem to be justified by experience to cover excess costs over the normal market values existing at the beginning of the project, due to fluctuations of price or other causes beyond control. Normal market values of similar and near-by property, as of the time of appraisal, should be the basis, with such additions as are warranted by the investigation in each case.

CONTINUOUS RIGHTS-OF-WAY

In the consideration of values of lands for rights-of-way for a railroad, an electric railroad, an aqueduct or other like property, or lands for a water-works or hydroelectric reservoir, where freedom of choice is restricted and all the land must be acquired, radically different methods must prevail.

In the valuation of lands of this class, a clear distinction should be made between: (a) Lands where the entire tract or parcel is taken and there is no element of severance damages, and (b) lands where only a portion is taken and the element of severance damages is present. The extent of lands of both classes should be shown.

Historic conditions, where ascertainable, should be given due weight in fixing the extent and character of the severance. All elements of value to the seller, in-

cluding recognition of all damages to the portions of his property not taken, which would prevail in the case of condemnation, should be considered.

A determination of the relation existing between actual recent acquisition costs and the normal market value of the lands out of which the strip or parcel was taken at the time of acquisition is undoubtedly possible in many cases. It would seem that where such relation can be determined its use in connection with the normal market values of these or similar lands at the time of appraisal should establish a reasonable cost of reproduction.

ALL REAL ITEMS OF COST TO BE INCLUDED

The determination of the figure to be used should be based in all cases on full consideration of the present normal market value of the area of land acquired and of other recent purchases by the same or other companies of similar lands in the vicinity or in districts of like characteristics; the damage to the remaining land, not required, due to severance and all consequential injuries; the amount and character of the costs of acquisition and overhead charges; enhanced prices due to active demand, and any other real items of cost which would be included in case of purchase. But no allowance should be included for special values coming after the acquisition of the property on account of its new use or on account of a greater earning power under the new use, or for any other hypothetical "value."

Estimates should be based on prices and values as of the time of appraisal, be they higher or lower than those prevailing at the time of original acquisition.

The treatment of the valuation of land holdings is not yet thoroughly crystallized; therefore the valuing engineer will do well to confer with counsel upon the interpretation of past court decisions and the legal principles which are most fairly applicable to the case under review.

OVERHEAD CHARGES

There are certain expenses called overhead charges, inseparable from the construction of any property, which are a necessary and proper part of its cost but are not capable of physical identification after the completion of construction work. These expenses cannot be covered in the estimate of cost of reproduction by the application of specific unit prices; from their nature they attach to the whole or large parts of the property rather than to any particular units.

Among the expenditures which must be provided for and classed as overhead charges are:

- (a) Cost of promotion.
- (b) Cost of financing and securing the necessary capital with which to carry out the enterprise.
- (c) Cost of organization, including the incorporation and organization of the company, securing of franchises, and other like expenditures.
- (d) Engineering, including the making of the preliminary investigations and plans, plans for the construction of the entire property, the engineering supervision of all construction and other work involved in the development of a property, except such direct supervision as may properly be included in the unit prices of various property units, or as specific charge against some particular schedule or group of units.

(e) Administration, including salaries for general officers, agents, accountants, clerks and other assistants not included in the engineering and legal departments, and all administration expenses.

(f) Legal expenses, including salaries and expenses of law officials and costs of litigation which, depending on the character of the property and its location, may be a comparatively minor item or a very large one.

(g) Interest during the period of construction on money borrowed or on money invested in the property by its owners.

(h) Taxes and insurance during construction.

(i) Contingencies, representing expenditures which cannot be foreseen but which from one cause or another are always of considerable size in the construction or reproduction cost estimate of any great enterprise.

Depreciation and Appreciation

With a desire to remove the ambiguity and resulting confusion that has attended the use of the term "depreciation" in connection with valuation, the committee has considered the subject from three standpoints: (1) The cause, *decretion* or loss of service life; (2) the record, *accounting depreciation*, or the money allowance made in bookkeeping to offset accruing loss of service life; and (3) the amount sought, *depreciation of valuation* or *fair depreciation*, the sum which should be deducted from original cost to date or from estimated cost of reproduction new as a step in finding that which the courts have called "fair value."

DECRETION OR LOSS OF SERVICE LIFE

Decretion is the fact of loss of service life of a physical property, property unit or item, regardless of its effect on value or anything else. It may be due to use, inadequacy, obsolescence or accident, either singly or in combination.

Although, in a well-maintained property, decretion is always present in some degree, yet in some cases this decretion, converted into loss of value, which loss is hereafter called cost of decretion, should not be considered to be a deductible quantity in finding the value of the property—that is, it should not be considered as depreciation of valuation or fair depreciation. Unfortunately, this has not been entirely understood.

Whether or not, and to what extent, if any, the loss of value due to existing decretion shall be deducted from original cost to date or cost of reproduction new, when finding "fair value" for any purpose, is the great troublesome problem of depreciation in valuation.

ACCOUNTING DEPRECIATION

The fundamentals of the methods of accounting for depreciation are that the owner of a public utility is under obligation to the investors in its securities to maintain the integrity of the investment as a continuing property and to furnish suitable service to the public; that the public is under obligation to the owner to pay a fair price for the service rendered, which should cover all operating expenses, a proper allowance for depreciation and a fair return upon the "fair value" of the property; and that the return to the investor and the rates to the consumer should be kept reasonably stable and uniform from year to year, and should be fair.

The four accounting methods in use for accounting for depreciation, the replacement method, the straight-line method, the compound-interest method (formerly called by the committee the "equal-annual-payment method"), and the sinking-fund method, yield identical total costs when the whole life of a property unit is considered, and any one of them seeming to be the most convenient may be chosen, provided only that under the circumstances it is legal, safe and fair.

The replacement method is applicable to short-lived properties or parts of properties made up of a large number of items, the replacement or retirement of which proceeds after a time with fair regularity and causes no troublesome variations in return or service rates; the straight-line method applies to any property units having more than a year of service life, which are assumed to depreciate uniformly from the beginning to the end of service life; the compound-interest and sinking-fund methods apply to property units the depreciation of which is assumed to progress at the same rate as a sinking fund grows from an annuity, accumulating at compound interest.

In addition to these four methods there is the unit-cost method, eminently sound in theory but not readily applicable to accounting purposes, based on the conception that the value of a plant unit should be decreased from year to year to such an extent that the cost per unit of output or service, taking into account all annual charges for interest, depreciation repairs, cost of operating, etc., should be constant during each year of the estimated service life of the unit.

The great discrepancy in the growth of depreciation of long-lived units under the straight-line and compound-interest theories should be carefully noted when determining which method to use.

It would seem fair in any given case to give the method of accounting used by the utility in setting up depreciation allowances its proper effect in determining deductible depreciation or the depreciation of valuation.

DEPRECIATION OF VALUATION

Dependence on Accounting Methods and Regulations—Finding the cost of decretion here defined as the loss of service life of an item converted into loss of value, is a step in the determination of depreciation, but whether and to what extent, if at all, the estimate thus found shall be treated as depreciation of valuation may be, and very probably will be, dependent, at least in part, on the methods of accounting for depreciation and the character of regulation that have prevailed.

Replacement Method—If by order or sanction of a regulating body, or by long-continued proper custom under no regulation, a property, as for instance a railroad, has been maintained in normal working condition, necessarily less than new in some or all of its parts, by the replacement method, and at any given date is being valued for any public purpose and at that date shows normal condition, all its several parts being in as good condition as could be expected, the accounts showing that those amounts have been expended in renewals that were necessary to keep the property in normal working condition, and the fact appearing that no expenditure reasonably to be expected could put the property in better than the normal condition in which it is found, and that no unusually large expenditure is

presently to be necessary for this purpose, then, in spite of the fact that there is an existing decretion in its several parts, there should be found no depreciation of valuation. Under the method of accounting the public has not paid, and could not pay, for the accrued depreciation, and under this condition its accrued obligation to pay should be considered an asset of the company owner.

If parts of the property are maintained under the replacement method and part by some proper allowance method, except as noted below, then depreciation of valuation should be found with respect to those parts maintained under the allowance method, but this depreciation of specific physical units will be made good in whole or in part by existing funds or property purchased with allowances, either or both of which will be included in the valuation as they are found.

WHEN TO DEDUCT DEPRECIATION

If in the judgment of the valuing engineer the replacement method may not be used with propriety for a given property, either because not in accordance with law, or because the method is not adapted to the property, then, whether or not the property has been maintained in the past under this method, the valuing engineer should estimate depreciation of valuation in the amount of the cost of the decretion he finds. There can be no certainty that the property will be properly maintained in the future.

When a comparatively new property, other than a railroad, is to be valued, and it has not been under any regulation that has affected its accounting methods, the law as laid down in the Knoxville decision would seem to make it necessary to find depreciation of valuation in amount equal to the cost of decretion found for all items, whether or not maintained by the replacement method. The committee, however, believes that this may work hardship and injustice in some instances, and suggests that in such cases the facts be reported with such recommendations as to equity as may seem fair to the engineer.

ALLOWANCE METHODS AND EFFECT OF REGULATION

Allowance Methods—If either the straight-line, compound-interest or sinking-fund method has been used in computing depreciation, and the method of accounting for it has been prescribed by a regulating body or voluntarily followed by a company owner from the beginning, the same theory, so far as it applies to the property in question, should be used for estimating the cost of decretion; and the entire cost so found, lessened by any accumulated depreciation funds, will appear as depreciation of valuation, unless the sinking-fund method of accounting has been used. In the latter case, if the valuation has to do with the reasonableness of the return and the accounting is to go on as before, apparently existing depreciation would not be depreciation of valuation, and therefore would not be deductible; but if the valuation has to do with condemnation or purchase, then, as in other cases, the apparently existing depreciation is depreciation of valuation, and the owner should receive the depreciated value of the physical property and the existing fund.

Effect of Regulation—Regulation which determines the method of accounting will in part determine the

amount of depreciation of valuation when finding "fair value," because it determines the method by which the public shall pay for the loss of service life. If the regulating body has prescribed the replacement method for the whole period that units have been in existence, then, although depreciation may exist, it is not depreciation of valuation, because, under the method of accounting, the public has not paid, and could not pay, for the accruing depreciation, and is still under obligation to pay for it.

WHERE DEPRECIATION ALLOWANCES WERE NOT FORMERLY GRANTED

Methods of accounting in force at the present time which make proper provision for the accruing depreciation should not have full weight if, in previous years during the life of the property units, other methods were in use which did not make provision for such depreciation. The amount of depreciation of valuation in such cases should be equivalent to the accumulated contributions of the public for depreciation allowances under the various methods of accounting which have affected the property unit from time to time. The public is still under obligation to make good that part of the loss of service life not yet paid for, and this obligation should be considered as much the property of the company usable to offset accrued depreciation as renewal funds or property actually in existence.

Whether or not this reasoning will stand in any case is for the court to determine. Valuing engineers and accountants should report what they find as to the actual cost of decretion, and the sums which have been received to offset such cost, under the methods prescribed by the regulating body from time to time. They may give their opinions as to the amount of depreciation that should be deducted from cost to find cost less depreciation as an element in the quantity known as "fair value."

WHERE PAST EARNINGS WERE LIMITED

If regulation has not fixed accounting methods, but has limited the earnings, it should be permissible to inquire whether the limited earnings have been sufficient to pay operating expense, depreciation, and fair return. If so, depreciation found should be considered depreciation of valuation to the extent warranted by the accounting methods lawfully or properly followed; if not, a question arises. It is remembered that the duty of the company owner is first to maintain the property "before coming to the question of profit at all," and that it is the duty of the regulating body to see that rates are such as to permit the company owner to earn operating expense, depreciation and fair return. If the regulating body has made sufficient earnings impossible, is it still the duty of the company owner to maintain the property before paying fair return to its security holders? If it is, depreciation of valuation should be found in the amount of the total cost of decretion or so far as warranted by the accounting methods followed. If not, depreciation found should not be considered depreciation of valuation except to the extent covered by earnings after deducting operating expense and fair return. This is a matter of equity to be determined by a court. If under regulation the property is a losing venture, it is not included in the class of properties now being considered. In any event the depreciation

existing should be found and reported, together with all pertinent facts, that the court may determine the equities of the case.

CONCLUSION UPON DEPRECIATION

The valuing engineer should bear in mind that when a company owner has invested a reasonable sum in a property for public service, it is entitled to, but not guaranteed, a fair return on its investment, so long as the money remains in the property, either as property, funds, or accrued public obligation to pay. Therefore, so long as the company owner keeps a sum equivalent to the total investment at work for the public, either as property serving the public, or funds held in reserve for such property, no policy should be followed in estimating depreciation that will reduce the property to a value less than the investment, or, when using cost of reproduction less depreciation, as a basis of "fair value," to a value less than the cost of reproduction of that part of the property estimated to have been created with company funds, acquired by gift, or in any way not the result of public contributions to cover depreciation.

APPRECIATION

Appreciation, largely the result of solidification, seasoning and adaptation, represents the improvement in quality and usefulness of certain parts of the physical properties of a railroad or other public-utility property. It results from the lapse of time, from work not specifically charged to capital account, from maintenance, from use, etc., and covers items, not represented either by the quantities or unit prices, that are determined in connection with a valuation.

There should be no general setting off of appreciation against depreciation, but appreciation should be determined independently from depreciation. Care must be taken that items of labor and expense included in the estimate may not be duplicated in development expense.

Development Expense

In the production of a normal going property, development expense, almost invariably, is an unavoidable real cost, and is measured by the difference between the amount which the company is entitled to earn in the early years and the amount which it actually does earn. The portion of this expense incurred in tuning up the property and bringing it to its present state of operating efficiency may be included in the cost of construction, and the remainder may be treated as the cost of acquiring the business.

Intangible Value

The intangible value that pertains to a property and should be given due weight in the ascertainment of "fair value" is the difference between the tangible value—that is to say, proper cost including development expense, less depreciation of valuation—and exchange value, in which is reflected existing and potential dependable income and beneficial results. It embraces going value, in which is merged good will, franchise value, efficiency, favorable business arrangements and design; and it also includes other elements, such as leases, easements, water rights, traffic and operating agreements, strategic location and advantages, and other privileges.

Oiled Road Through Mojave Desert Built for \$950 Per Mile

**Eight-Foot Strip Treated with 2½ Gallons Per
Square Yard, Worked with Harrows and
Rolled with Horse-Drawn Roller**

By J. S. BRIGHT

Chief Engineer, San Bernardino County Highway
Commission, California

TO build 80 miles of oiled road through the Mojave Desert in California at a cost not exceeding \$1,000 per mile was the task which the San Bernardino County Highway Commission undertook recently and is now completing. The desert section of the route is only part of a program of new construction financed by a bond issue of \$1,813,000. Of this amount \$125,000 is being spent on the desert highway and the remaining \$1,688,000 on 187 miles of concrete and macadam roads in the fertile districts of the county.

The desert road which is being improved is the



APPEARANCE OF COMPLETED DESERT ROAD

Santa Fe Old Trails transcontinental highway, 290 miles of which is within the boundaries of this county. Fifty miles of this road within the fertile districts has been paved with concrete and macadam, leaving 240 miles to be made passable with the fund of \$125,000. Of the 240 miles of desert road, 160 miles is a good earth road, needing no particular work except grading to make it passable. It was estimated that \$1,000 per mile would be all that was available to spend on the remaining 80 miles.

DESERT SOIL VARIES

The desert is not, as commonly believed, an endless waste of drift sand, but the soil varies according to the location and slope of the country. The steeper slopes are of hard gravelly clay or a lime formation called caliche, both of which make good natural road surfaces. From the steeper slopes to the bottom of the valleys the soil grades from good gravel to fine sand. One exception to this rule is a stretch from Lavic to Bagdad, where areas of volcanic ashes are encountered. These beds of ashes are generally hard when the loose top surfaces are removed, but soon powder into dust and wear into chuck holes under traffic.

In locating the road it was found that it was sometimes impossible to avoid poor road soil and that a surfacing had to be provided where the line crossed the bottom of the valleys and the beds of volcanic ashes. Drainage had also to be studied as carefully as if in a



THE ROAD WAS FINISHED WITH A 6-TON ROLLER DRAWN BY HORSES

humid climate. Though the annual rainfall is only about 2 in. it generally falls in 2 hours and results in heavy floods. It is not practicable to provide storm ditches and bridges. To overcome this difficulty the road grades were made to conform with the profile of the ground, with the center as near as possible at right angles to the drainage. No fills were made at the washes, but the banks were always cut back to dip the road to the grade of the creek bed. Wherever possible the highway has followed the lower side of the Santa Fe Railroad both to get protection from storm water and to obtain a short haul for material shipped by train.

Weather conditions reach extremes on this desert, the temperature being subject to great variations, ranging from 115 deg. Fahr. in summer to freezing in winter. Windstorms are prevalent in spring and in autumn. The atmosphere is always very dry and has a disastrous effect on all wooden road machinery.

The traffic consists principally of automobiles carrying transcontinental touring parties. Horse-drawn vehicles are rare. The most serious menace to the road surface is an occasional fleet of trucks going to a mining boom, heavily laden with fuel and oil. Wherever these trucks strike a sand stretch they invariably stall, dig up long stretches of the wheel tracks and pound the surface into ruts.

CALICHE SURFACE TRIED FIRST

The San Bernardino County Highway Commission first tried covering the road with caliche or hand-screened gravel, but soon found these surfaces had to be finished with asphaltic oil to prevent rubber tires from sucking the finer particles loose from the body of the covering. This type of construction could not be completed for less than \$2,000 per mile.

The second plan tried was an oiled petrolithic surface, which produced a good road, but for an 8-ft. driveway it cost about \$1,500 per mile.

The plan finally adopted was to oil an 8-ft. strip, working the oil with harrows, omitting the petrolithic tamper and depending on the traffic to do the latter's work. The saving made with this system was mainly in the amount of oil used. In the petrolithic plan it



CATERPILLAR TRACTORS WERE USED TO HAUL OIL

took at least 4 gal. per square yard of oil to produce a surface, but with the last method it averaged only about 2½ gal. per square yard. The cost for an 8-ft. roadway was about \$950 per mile.

During the hot weather 80 per cent asphaltic road oil was used, but during the cool weather and on the stretches of volcanic ashes 75 per cent asphaltic oil gave better satisfaction. This oil must be heated before unloading and spreading. To accomplish this a 30-hp. portable boiler and feed pump are used. The oil is generally handled at a temperature of 175 deg. Fahr.

The roadway is prepared by grading a width of 20 ft. with a blade machine, starting on the high side and working the material to the lower side, keeping the roadway cross-section as nearly level as possible. This has the result of lowering the roadway to allow the storm runoff to pass over without washing and also leaves a coarse material, as the top 6 in. is generally drift sand. Two four-horse fresno teams follow the graders to remove the bumps. Two men throw out all surface rocks of any size. This work costs from \$50 to \$210 per mile.

To make the material uniform after the grading is

CONSTRUCTION OF 8-FOOT OILED DESERT ROAD

	Cost per mile
Hauling oil with teams	\$100
Heating oil	15
Oil	375
Cultivating and dragging	80
Maintenance of equipment	25
Superintendence and overhead	50

completed, and to assist the oil to penetrate, the surface is worked for a depth of 3 or 4 in. with a goose-neck harrow for a width of 8 ft.

OIL APPLIED IN THREE COATS

The oil is applied in three coats. The first two coats are of 1 gal. per square yard each, and the last coat of ½ gal., unless the material is especially fine, when it is necessary to apply as much as a full gallon. Each coat is thoroughly incorporated into the road surface by working it with a spike-toothed harrow, followed by a road drag. After the third coat is applied and dragged the traffic is allowed to come on for two days; then the road is again dragged, and with the traffic this operation is again repeated until all soft spots disappear. The road is finished by rolling with a 6-ton horse roller. Power rollers are impracticable while the road surface is still new.

To maintain this road surface it will be necessary to keep a patrol truck loaded with oiled gravel constantly at work tamping up the weak spots. Every four or five years the surface should be rooted up with a power roller and rerolled, followed by a seal coat of oil, which should gradually produce a good road and a fairly economical one for the class of traffic expected.

This work, like all the improvements handled by the San Bernardino County Highway Commission, has not been done under the contract system, but has been handled by the chief engineer through a superintendent under his direction, who hires all the labor and teams by the day.

Caterpillar tractors were tried for hauling, and were economical during very hot weather on long hauls, but

during cool weather and on short hauls teams are better, mainly because of the destructive effect of the tractor on the wagon trains. The side thrust on the lead wagon of a three-vehicle train making a short turn is excessive and is especially destructive to wooden wheel hubs if the temporary road is loose sand mixed with occasional rocks.

Trucks for hauling oil are out of the question unless there is good oiled material to travel over. Undoubtedly trucks can be used in maintenance work in applying the seal coats. The chief items of construction cost are given in the table on page 65.

San Bernardino County was fortunate in having three very energetic commissioners, who spent considerable time from their ordinary business to look after the many details resulting from day-labor work. B. R. Kennerley was superintendent in charge of the largest portion of this desert work.

New Steel Column Tests Reported by Special Committee

Results Given for Extension of Original Program of Investigation at U. S. Bureau of Standards Completed During Past Year

RESULTS which, in general, confirm the tendencies reported last year by the special committee on steel columns and struts of the American Society of Civil Engineers in its progress report (abstracted in the Engineering Record of Jan. 15, 1916, page 81) have been obtained in the supplementary tests completed during the last year. As recorded in the progress report of this committee printed in the *Proceedings* for December, page 1643, the tests on columns of extra-heavy metal show decreased ultimate strength for H-columns but little decrease for the built-up I-sections. Tests on new short columns with a slenderness ratio of 20 confirm results obtained for retested columns of similar form. Relatively less reduction of strength for heavy sections is found for the long columns with a slenderness ratio of 155. The abstract which follows includes the most significant parts of the report and the results of the new tests.

THREE LINES OF INVESTIGATION COMPLETED

Three lines of investigation, mentioned in the last progress report, have now been completed. They are: (1) New short columns of a slenderness ratio of 20 supplement the tests of similar columns cut from longer columns already tested; (2) new columns of extra-heavy material, both of the Bethlehem H-section, type 5, and of the built-up I-section, type 1, show the effect of heavier material, and (3) long columns of slenderness ratio 155 widen the scope of the inquiry.

The results are indicated in the accompanying table. In addition, there are included a set of tests of Carnegie mine-section H-columns, consisting of light columns donated to the bureau as mentioned in the last report.

The fact that the ultimate strength of heavier sections for the new short columns, of $l/r = 20$, exceeded that of the light sections does not tell the whole story. As in the case of the retested columns reported last year, the yield points of these new columns reverse this relation. These yield points average 26,000 for the heavy

sections and 31,700 for the light sections. Comparing the stress-strain curves with those of last year's report it is seen that approximately the same relative difference exists between the yield points of the light and heavy material for these short columns.

The extra-heavy Bethlehem H-sections, with a nominal area of 26.64 sq. in., show a marked falling off in ultimate strength for all three slenderness ratios. On the other hand, the extra-heavy plate and angle columns of 13/16 and 7/8-in. metal show very little reduction in

Average Results of Tests on Steel Columns for Joint Committee

(Each value is the average of three tests)

Length ratio	AVERAGE ULTIMATE STRENGTH IN POUNDS PER SQUARE INCH		
	Light sections	Heavy sections	Extra-heavy sections
<i>Type 1 Built-Up I-Section</i>			
20 Old	36,400	44,400	
20 New	38,200	43,600	
50	32,700	29,200	
85	31,200	28,100	27,700
120	28,300	25,400	
155	26,200	22,700	
<i>Type 2 Box Section--6-Inch Channels, 8-Inch Plates</i>			
50	33,900	32,300	
85	32,600	30,600	
120	29,300	28,100	
155	26,500	24,900	
<i>Type 4 8-Inch I-Beams and 2 Channels</i>			
50	36,900	29,100	
85	34,000	26,600	
120	31,900	23,900	
155	23,600	23,300	
<i>Type 5 8-Inch Bethlehem H-Section</i>			
50	38,000	35,400	25,200
85	34,300	32,300	23,500
120	32,000	30,000	21,300
<i>Carnegie Mine Sections LIGHT SECTIONS</i>			
	6-in. H	8-in. H	
50	31,000	33,500	
85	30,400	31,700	
120	27,200	29,200	

Results of Tensile Tests of Metal in Specimens from Columns

Area of columns, square inches	Thickness of specimen, inches	Yield point, pounds per square inch	Ultimate strength
<i>Type 1--Built-Up I-Section</i>			
11.47	0.31	37,000	57,100
22.19	0.62	32,000	55,600
28.61	0.81	33,000	57,000
<i>Type 5--8-Inch Bethlehem H-Section</i>			
9.17	0.32	38,000	59,000
18.27	0.55	33,000	57,500
26.64	0.78	26,000	46,500

strength when compared with the heavy sections tested last year.

As the results for the high slenderness ratio of 155 had only just come to hand, the committee published them without comment. The investigations are now complete with the exception of three columns ordered for a preliminary investigation concerning eccentric loads. The problems presented by the tests thus far made in this investigation have produced so many complications that the committee has asked the Bureau of Standards to study the question of procedure. Supplementary tests on short columns cut from previously tested columns were made, but the committee deemed it unnecessary to make abstracts of these tests, as the ultimate strength is hardly a factor for such short sections.

To determine whether the lower strength of heavy sections is caused by the metal itself, tensile and compressive tests have been made of specimens cut from

the webs of the Bethlehem H-sections and from outstanding angle legs of built-up I-sections for the tensile tests and of 5 x 3-in. angles for the compression tests reported.

The results of tensile tests are indicated in the table herewith, the stress-strain diagrams not being reproduced. The compressive tests on angles of length ratio 12.7 gave a yield point of 35,000 for the angle of 2.41 sq. in. area (5/16-in. thick), and 29,500 for that of 4.61 sq. in. area (5/8-in. thick).

These specimen tests indicate the difference in strength between thin and thick material. It would seem that the strength of the full-size columns is determined by the yield point of the specimen tests rather than by the ultimate strength. Apparently the tensile and compressive tests agree in showing the same relative yield points.

The committee points out the close relation which exists between yield point of the metal and the ultimate

Railway Coaches Equipped as Camp Buildings for Lumber Crew

Standard-Gage Cars Include Kitchen, Bunk Rooms, Blacksmith Shop, and Engineers' Office in Mobile Units

ARRANGED and equipped to replace the usual temporary camp used by a logging crew while getting out timber, twelve standard gage railway cars were built in 1914 for the Cherry Valley Timber Company of Everett, Wash. They include kitchen, dining and bunk rooms for the men, blacksmith shop, engineers' and administrative offices, as well as equipment for heating, lighting and water-supply systems.

The company handles its logs on a steam railroad. Before the completion of the logging operations which are contemplated the rail line will tap every part of the woods. It was therefore feasible to construct the camp



THE CAMP BUILDINGS CONSIST OF SPECIALLY DESIGNED STANDARD-GAGE RAILWAY CARS, FULLY EQUIPPED

strengths of columns, and states that one of the first questions to settle is what shall be taken as the yield point of the metal. Reference is made to the discussion on yield point by the American Society for Testing Materials (see Engineering Record, July 15, 1916, page 78); modifications of some of the methods there suggested have been considered and the committee hopes that the data now being accumulated will assist in determining a practical solution.

A field of inquiry which is comparatively unexplored, according to the committee, is opened up by the question whether the same method for yield-point determination of the specimens can be applied to the columns, or if not, how this point shall be located. It is noted that the stress-strain curves of short columns show the rate of compression after the load has passed the yield point to be such that the column has ceased to have structural value above this point.

The questions of deformation point and ultimate strength, of safe working values, and the influence of lattice bars, tie plates and end connections, or the effect of details, yet remain to be determined. The committee hopes to formulate recommendations for designing columns during the coming year, and expresses appreciation of the cordial co-operation and assistance of S. W. Stratton, director, and G. R. Olshausen, engineer-physicist, of the U. S. Bureau of Standards. George H. Pegram is chairman and Lewis D. Rights is secretary of the committee.

equipment in cars that could be moved about as the work advanced, and which would afford conveniences not found in the usual temporary camp. With cars the camp cost is lower, when the time required to complete the work is taken into consideration.

The first camp built on this plan was so successful that an order for another twelve cars was placed, and a new camp, much like the first, is soon to be in use. As a result of experience with the first camp, the design of the new cars was slightly modified.

The new cars are all 14 x 60 ft. in plan, except the kitchen, which is 14 x 36 ft. From rail to sill the height is 4 ft. 7 in., from sills to eaves the height is 10 ft. 2 in., and from eaves to clearance 3 ft. 10 in., making a total of 18 ft. 7 in. over all.

The camp is heated by a 35-hp. Scotch marine boiler burning oil supplied from a 2115-gal. steel tank in the engine room. This boiler supplies steam which heats all of the rooms except the storerooms. A 3½-kw. dynamo provides current for 164 lights, most of which are equipped with 16-cp. Mazda lamps. In the blacksmith shop a drill press and an emery wheel are driven by a 3-hp. motor. One entire car is devoted to bath and dry rooms. This car is equipped with a separate heating system, so that the hot-water supply there is independent of the boiler plant. The dynamo room is 14 x 14 ft. in plan, the boiler room 14 x 20 ft., and the blacksmith shop 14 x 26 ft., these three rooms all being contained within one 60-ft. car.

Engineer Salaries as High as Those of Other Professions, Says Committee

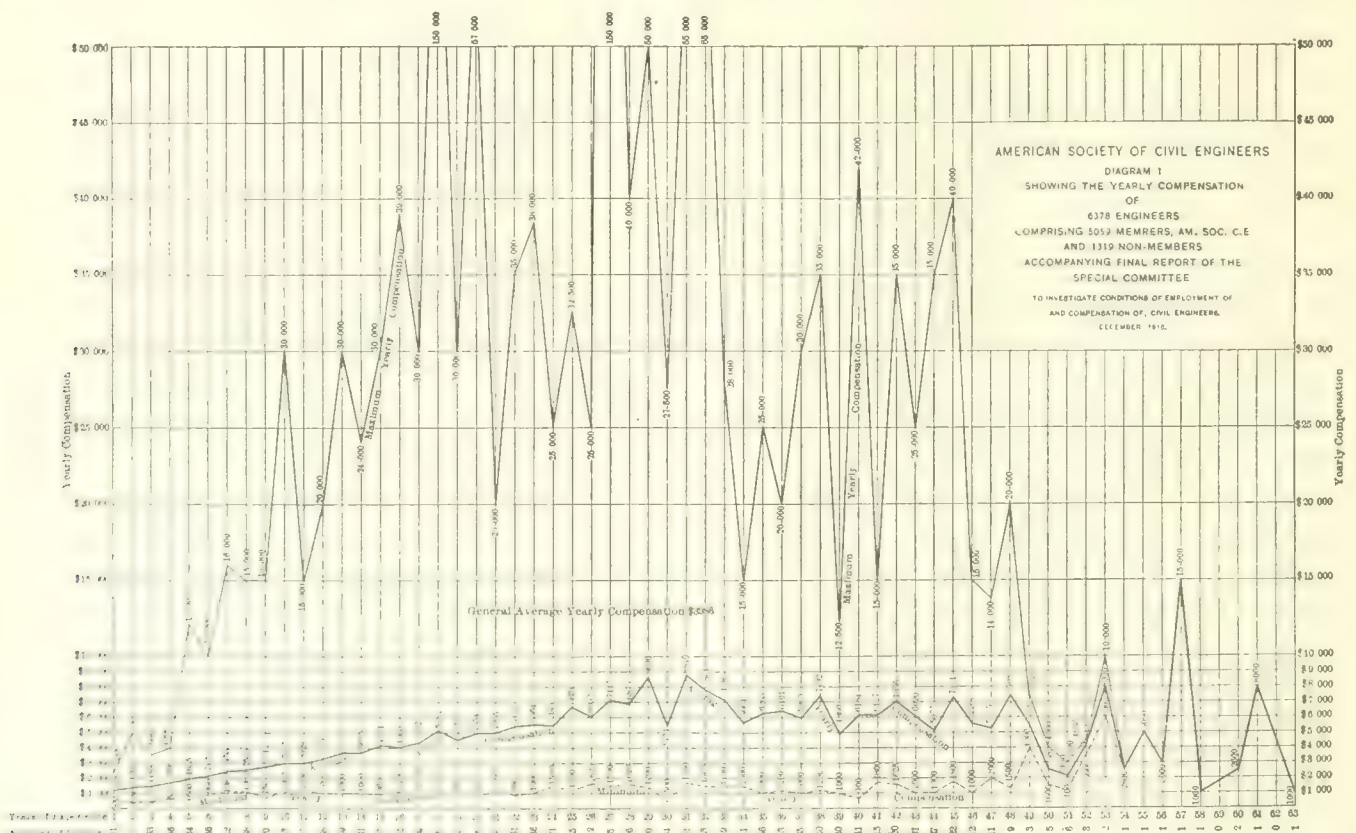
Investigation by American Society of Civil Engineers Indicates Annual Average Compensation of \$3,986—Engineer Employers Underpay Their Men

IN its final report in the December, 1916, number of the *Proceedings*, page 1603, the special committee of the American Society of Civil Engineers, appointed to investigate the compensation of members of the profession, reaches the conclusion that "the compensation for engineering work compares favorably with that received by men of any other profession," although in arriving at the annual average individual compensation of \$3,986, based upon reports from 5059 members of the society and 1319 non-members, no consideration is given to the salary schedules of such large employers of technical services as railways and other corporations, municipalities, states and federal departments, from whom, the committee states, "it has not been possible to secure any information of value." A comparison of the diagrams in the final report with those previously submitted (see Engineering Record of Jan. 30, 1915, page 139) shows, according to the committee, no substantial changes, in spite of the broader scope of its later work. Underpayment of engineers, the committee points out, is often the fault not of an unappreciative public but of their own engineering superiors in office. Except during the first five years of practice, technical-school graduates receive higher compensation than non-graduates. As for compensation by classes, contractors are the largest money-makers, followed by consult-

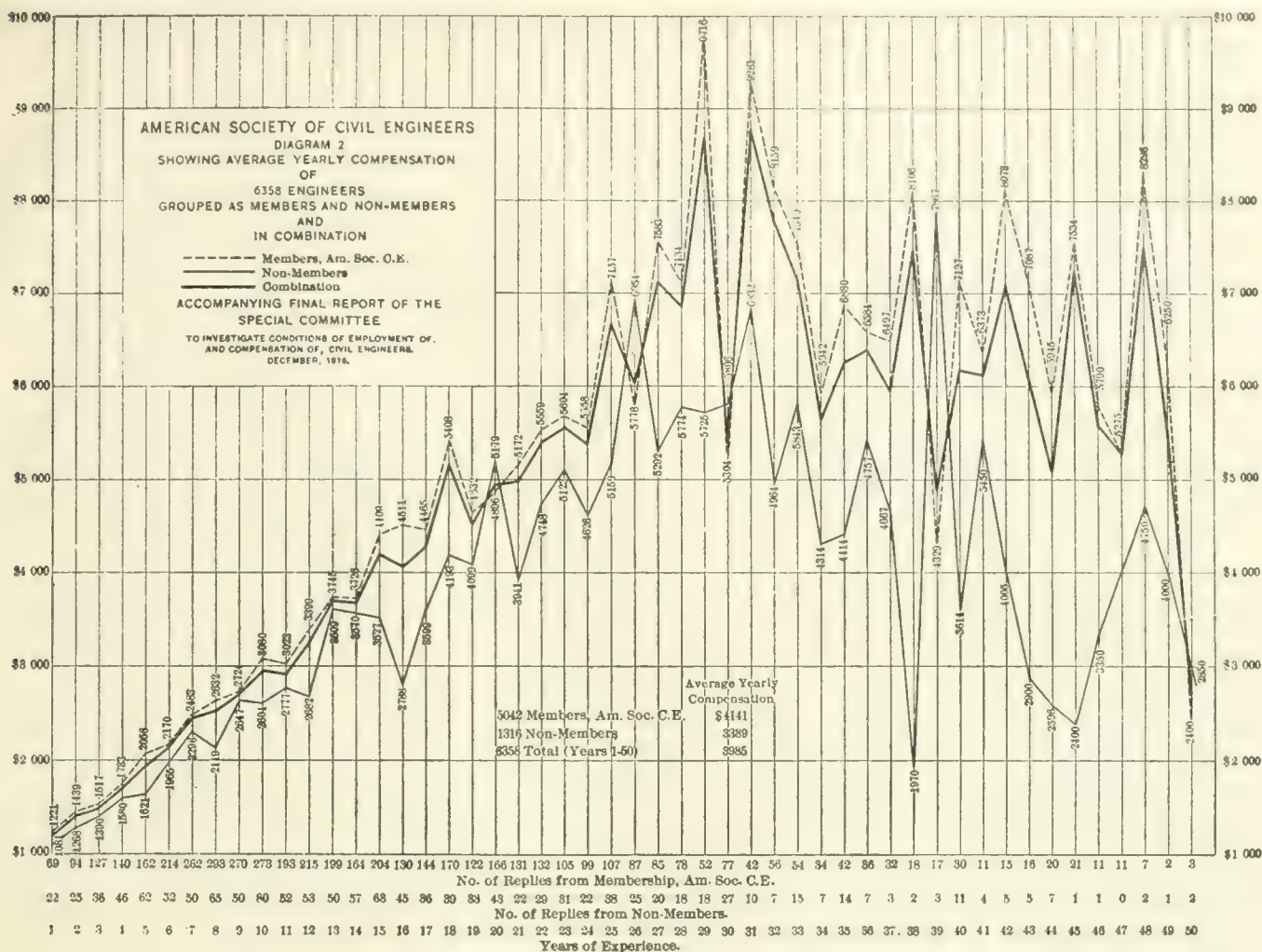
ing engineers, engineers in private companies, railroad men, members of technical-school faculties, municipal employees, federal government employees, and, finally, employees of states and counties. The committee, from whose report the following extracts are taken, consisted of Nelson P. Lewis, chairman; John A. Bensel, S. L. F. Deyo, Dugald C. Jackson, William V. Judson, C. F. Loweth, and George W. Tillson.

During the summer of 1915 the committee addressed the same questions which were addressed to those whose replies formed the basis of its last report to those who had become members of the society since the last preceding circular was sent out, the number of inquiries so sent being 599, from which 263 replies were received. Inquiries were also addressed to 6393 non-members of the society, whose names were secured from the membership lists of fifteen local engineering organizations in different parts of the country. From these non-members 1319 usable replies were received, which, together with the additional members of the society heard from, brings the total number of returns received by the committee to 6378.

The committee has considered the advisability of addressing letters of inquiry to members of the other national engineering societies, but has concluded that this would be inexpedient, for the reason that there are



1 MAXIMUM, MINIMUM AND AVERAGE COMPENSATION OF 6378 ENGINEERS, INCLUDING 1319 NON-MEMBERS OF THE SOCIETY



2—COMPENSATION OF 6358 ENGINEERS, SHOWING COMPARISON BETWEEN MEMBERS AND NON-MEMBERS OF THE SOCIETY

quite a number of members of these societies who are also members of the American Society of Civil Engineers, and they are probably those whose compensation or income from professional work is above the average, so that, if those who are members of this society were excluded, the result would not indicate the average compensation of members of the other societies, and might be misleading.

LOW-SALARY DATA LACKING

The committee also made an effort to secure information from the different engineering schools, but it was found that, with two exceptions, the statistics collected by these institutions concerning their graduates, with respect to the matters which have been the subject of the committee's investigations, were so incomplete that this idea had to be abandoned. An attempt was made to secure pertinent data from officers of railway and other corporations, municipalities, states, and federal departments which employ large numbers of engineers, but they appeared to consider it impracticable to undertake the collection of such data for the committee, and, without their active co-operation, it has not been possible to secure any information of value.

The committee, therefore, is obliged to base its third report on the information received from the 6378 engineers who have replied. That these figures are worthy of serious consideration is obvious from the fact that

the 5059 members of the society represent a gross annual professional income of not less than \$20,952,952, while the 1319 non-members represent a gross annual income of \$4,467,709, or a total for those whose replies form the basis of the report of \$25,420,661.

The returns from the 263 additional members of the society, the great majority of whom were younger men, when combined with those covered by the last report, result, as might have been expected, in lowering the average compensation from \$4,224 to \$4,142, or \$82. The average annual compensation of the 1319 non-members is \$3,387, or \$755 less than for the members of the society, including the latest returns. The committee realizes that in directing its inquiries to individuals outside of the membership of the society, but members of local engineering organizations, it has addressed a number of men who are not really practising engineers, as the local engineering organizations almost always include in their membership men who may be simply interested in engineering and some who have done little, if any, professional work, and they have been frank enough to say so in their returns, and their replies are not included in our statistics.

Twenty-two of the replies indicated that the men who made them are employed as sales engineers or in other lines of commercial work, although they are graduates of engineering schools. These men appear to have turned their attention to this kind of work immediately

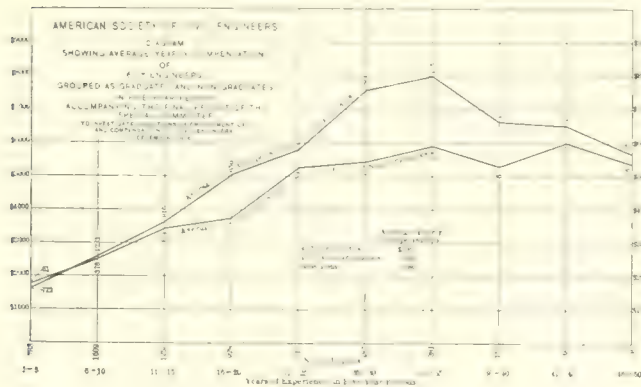
after graduation. The committee has not included these returns in its compilation, but they are so significant as to be deemed worthy of comment. They include men whose active work covers periods of from 1 to 22 years, although in all but four instances their experience in work of this character has been 10 years or less. A comparison of their earning power with that of men engaged in what is generally considered to be strictly engineering work indicates that it agrees very closely with the averages shown by the diagrams, even though the responsibilities which must be assumed are less than those of the practising engineer.

FIVE DIAGRAMS SUBMITTED

The committee submits five diagrams, as follows:

1. A diagram similar to that reproduced as Plate XL in the last report (*Proceedings, American Society of Civil Engineers, Dec., 1914*) showing maximum and minimum average annual compensation for professional work of 6378 engineers, including 1319 who are not members of the society.

2. A diagram showing the average yearly compensation of 6358 engineers, divided into members of the



3—WHAT GRADUATES AND NON-GRADUATES EARN

society and non-members, together with the combined average.

3. A diagram showing the average compensation of graduates and non-graduates, arranged according to 5-year periods.

4. A diagram showing the average compensation of engineers grouped according to nature of service.

5. A diagram showing the average compensation of engineers arranged in six geographical groups.

The first diagram includes all the returns which have been received. The second and third include all returns covering professional activity of 50 years or less, while the other two cover all those which are capable of being classified with certainty and which include 40 years or less of professional work.

EFFECT OF \$25,000 INCOMES

The committee has considered the question as to whether exceptionally large professional incomes, say those above \$25,000 a year, might not be due to some fortuitous circumstance or condition entirely apart from professional ability, and whether they should not be excluded from consideration in the preparation of the diagrams by arbitrarily reducing them to \$25,000. This was tried, and, while the effect was to modify very materially the curve showing maximum professional in-

comes, its effect on the curve of average compensation was very slight. The committee believes that the data collected include practically all the very large professional incomes, and that an increase in the number of returns would tend to eliminate the irregularities of the curve. The committee's conclusion has been that the returns should be shown as they were received.

A comparison of the diagrams with those presented with the last report will show that the broader scope of the committee's inquiry has not produced any substantial changes in the results heretofore submitted. The line indicating the average compensation of non-graduate engineers falls below that showing the compensation of graduates, except during the first part of the first 5-year period, where the professional earnings of non-graduates appear to be slightly greater than those of graduates. The committee has communicated with bodies which are collecting data concerning professional education, in the hope that it might secure information relative to the compensation of men engaged in other kinds of professional work. Its inquiries have not produced any definite results, and, so far as the committee can learn, no data as complete as are herewith presented have been secured with respect to them. From such meager information as was obtainable, the committee is convinced that the compensation for engineering work compares favorably with that received by men of any other profession. Engineers, like other professional or business men, are frequently desirous of being connected with important undertakings which will give them valuable experience and a certain prestige, and, in order to gain these, they are willing to accept salaries which are very small in comparison with the value of the services rendered.

ENGINEERS UNDERPAY THEIR OWN MEN

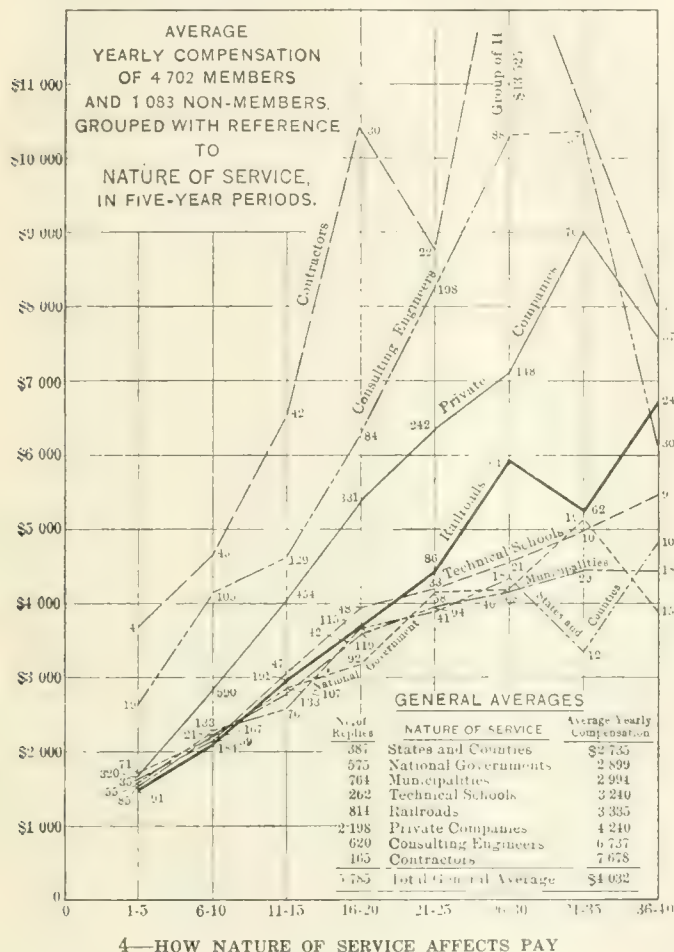
The underpaid engineer does not always owe his failure to receive a salary commensurate with the importance or difficulty of his work to the ignorance or lack of appreciation of laymen, but it not infrequently is the fault of his engineering superior in the organization of which he is a part. The replies received by the committee indicate that engineers in private practice sometimes employ men of extensive experience, and presumably of good ability, at salaries which young graduates with little or no experience are able to command, but which are less than those of an ordinary mechanic who has a labor organization behind him.

It may be urged that the competition for work on the part of engineers who employ a technical staff is so keen that it is necessary to take advantage of the needs of those seeking employment in order to secure professional work which is frequently let to the lowest bidder. Engineers in private practice are often criticized because they have not established a scale of charges on a percentage basis as have the architects, but in the offices of leading architects will be found young men who are willing to work for almost nothing for the sake of the experience they hope to gain. The fact remains that employing engineers are sometimes disposed to pay their men less than their services are actually worth. The Code of Ethics, adopted by the society by letter-ballot on Sept. 2, 1914, lays special emphasis upon the relation of the engineer to his client and to that of competing engineers, who may be striv-

ing to secure the same contract or commission, toward each other, but it makes no mention of the obligations of the engineer as an employer to men of his own profession. It appears to lose sight of the need of guarding against underpaying and underbidding.

The engineer, in some branches, unlike other professional men, is frequently unable to locate in one place until he can become known, even though his reputation may be local. He must go where work is in progress, and, when the particular work on which he has been engaged shall have been completed, he must move on to

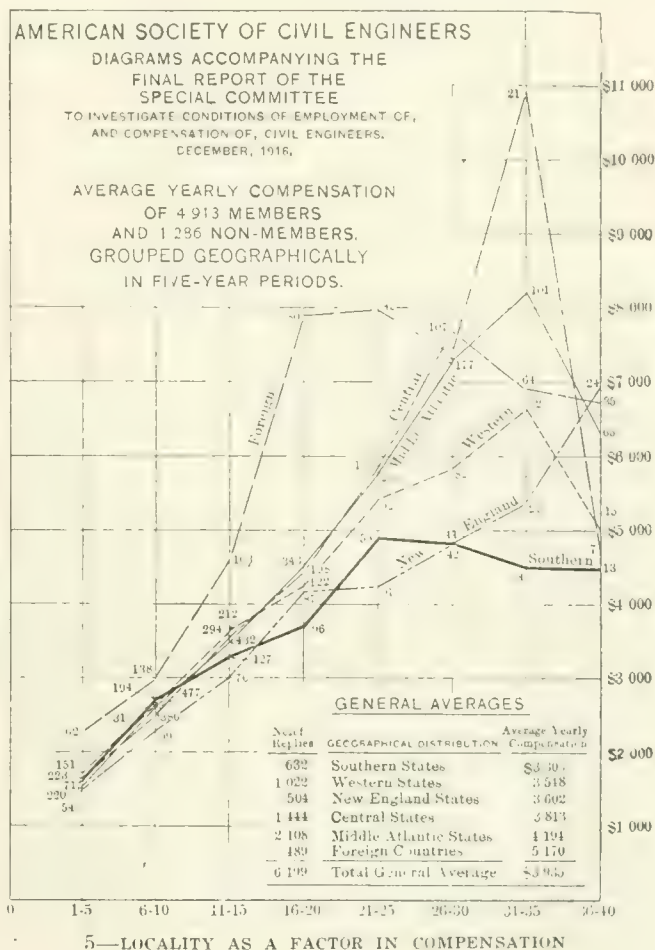
putable fact that young graduates of engineering schools reach a self-sustaining basis, where they are at least able to support themselves, more quickly than do those of other professions. Much has been said lately about the general decrease in the registration at engineering schools, and this has apparently been viewed with alarm by their faculties. The committee does not consider it a bad omen for the profession. There is a need of better trained engineers rather than of more engineers, a need more particularly of men who are better grounded in the fundamentals of the engineering



another place. Periods of unemployment are fatal to steady advancement, while a reasonable prospect of promotion, however slow, is likely to prompt men to accept less than the average compensation for the kind of service rendered.

ENGINEER SUPPLY AND DEMAND

In reading the observations made by those who have commented upon the compensation of engineers and the conditions of their employment, it has appeared to the committee that many of those which appear cynical or pessimistic have been made by men who would probably have been failures in any occupation or profession, men who do not possess adaptability or even a fair degree of industry, and who attribute their failure to their unfortunate selection of a profession. These comments should not be given much weight. Perhaps there are too many engineers, but the eagerness of young men to adopt this profession is doubtless due to the indis-



sciences and who have at the same time acquired some knowledge of the economic or business aspects of engineering work, rather than of men who may have the greatest earning capacity on the day of their graduation.

Holding Power of Nails

A few experiments to determine the holding power of 16d. and 20d. nails in a direction perpendicular to the length of the nail were made recently by J. C. Stevens, consulting engineer, of Portland, Ore. Ordinary 2 x 12-in. yellow-pine planks were nailed to fir sills and then sheared off. From these experiments a safe loading of 210 lb. for 16d. and 250 lb. for 20d. nails was assumed for use in the heel plates of the wooden flumes on the West Okanogan irrigation project, described in the Engineering Record of Nov. 25, page 640. These figures are believed to be higher than usual.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Army Engineer Corps Aids in Flood-Relief Work

SIR: Following the great storms of July, 1916, which did such damage in the states of North Carolina, South Carolina, Georgia, Alabama, Florida and Mississippi, Congress adopted a joint resolution appropriating \$570,000 and authorizing the Secretary of War to provide relief for the sufferers.

The resolution set forth three methods for furnishing relief:

1. By supplying such seeds as may be suitable to produce quick-growing crops to provide food for the population and animals.

2. By providing employment under the supervision of army officers and in co-operation with local officials.

3. By furnishing supplies of the Quartermaster and Medical Department for a limited time to those who are destitute and unable to work.

The quick-growing seeds were supplied through the Agricultural Department, and all other relief measures were administered by the Secretary of War through the Engineer Corps of the U. S. Army.

The devastated sections were almost entirely agricultural, and owing to local conditions the problem was one of helping the people over a period of three or four months that must be lived before they could begin to realize on new crops.

Great care had to be exercised in the administration of relief to prevent pauperization. All applicants for free supplies or medical attention were subjected to careful examination and investigation to prove that they were both destitute and unable to work. The amount of such free supplies issued was relatively small. Most of the relief was given by employing the destitute on road work, there being not enough river improvement or other public work of the United States to furnish employment to the destitute in the stricken localities.

The road work was carried on in co-operation with the state, county, and other local officials. Only those actually destitute were employed, and, more fully to safeguard the United States against abuse of its effort to help the deserving, the wages paid were fixed at from 50 to 75 per cent of the current wages in the locality.

The work on the roads was confined almost entirely to grading and drainage by hand labor, as in that way the greatest benefit could be derived, and practically all the money expended went direct to the laborers, very little being needed for the purchase of material.

W. M. BLACK,

Chief of Engineers, U. S. Army.

Washington, D. C.

[The success of the efforts of the government is attested by the following letter sent to General Black by Senator Underwood of Alabama.—EDITOR.]

MY DEAR GENERAL BLACK: I write this letter to express my thanks to you and the other members of your corps who accomplished the great work of relieving our people in Alabama from the flood situation last summer. The work was splendidly done. The relief was immediate, and accomplished the results desired without bringing any demoralization in its wake. Our people were thoroughly satisfied with its accomplishment, and I have heard no complaints and only praise of the efficient and capable way in which you and the members of your corps handled the situation.

With kindest regards, I am,

Cordially yours,

O. W. UNDERWOOD.

Federal Support for Research

SIR: I have noted with great interest your editorial of Nov. 25 upon "Leadership Through Industrial Research." I am glad also to take this opportunity to express my gratification of the fact that your paper does not hesitate to take and express a statesmanlike and far-seeing position in all those matters which affect the engineering profession at large. I trust that you may continue and extend this policy in the future.

My special purpose in writing, however, is to invite your attention to a certain bill now in congressional committee and to ask your assistance in bringing it to the attention of engineers generally. I refer to the Newlands bill, Senate No. 4870, in charge of Senator T. P. Gore, committee chairman. As originally presented, this bill provides a lump-sum appropriation of \$15,000 annually to each of the agricultural and mechanical colleges of this country for engineering research, the same being a continuation of the policy of the Morrill act. The fact has developed, however, that there were doubtless many engineering schools other than the agricultural and mechanical colleges, including state universities and privately endowed schools, which are in a better position to carry on engineering research than these schools alone.

At a recent meeting of the Association of State University Presidents, a majority of whom were in charge of agricultural and mechanical colleges also, it was decided to recommend amendments to the bill in at least two important particulars:

First, to provide for a central governing board which should decide what investigations would most benefit the nation at large, and as a corollary to determine to what available school or group of schools a given problem could most properly be assigned.

Second, that the total amount of money provided should not be made available the first year, but that ten selected institutions should start the work, and five more be added annually until the whole appropriation was being absorbed.

The main principle seems to be that there is not any inherent or logical reason why federal aid should not now be properly extended to general engineering research, under the most favorable conditions, as well as to the agricultural interests exclusively, which was doubtless the guiding aim of the Morrill act.

If you feel that this is a subject in which you can properly interest yourself, and we confidently believe that you do, we trust that you will take appropriate action in the near future, as the bill is expected from the committee at an early date.

JAS. I. TUCKER,

Professor of Civil Engineering, University of Oklahoma.

Norman, Okla.

[In discussing this bill, March 25, 1916, page 405, the Engineering Record held that the states should furnish the money for the stations themselves, or that at least the states should match the federal appropriations dollar for dollar. The need for central supervision was also emphasized. We are glad to note that the colleges have agreed to modify the bill in accordance with the last suggestion. We still hold, however, that government money should be given as encouragement only—a means whereby the states themselves will be induced to finance engineering experimental work.—EDITOR.]

Motor-Truck Regulation and the Protection of Road Surfaces

SIR: Concerning the discussion of highway regulations for solid-tire, heavy trucks, whether horse-drawn or self-propelled, I would like to call attention to the fact that although the fixing of maximum loads in terms of width of tire will accomplish good, it is not altogether a complete nor a practical way of securing best results. Assuming that the wheels have a solid rim, there is somewhere a practical limit to the width of tire beyond which further widening will not obtain results comparable with the results obtained before such limit was reached.

Since, in general, road surfaces are either irregular or convex, it is evident that a cylinder rolling along such road will not be in full bearing throughout its lower elements, but that the load will be concentrated more or less completely on certain parts of such elements. It is possible, moreover, that at sharp turns the wide tire may prove objectionable.

If width of tire were the sole legal requirement it probably would be necessary in the case of very heavy loads (in order to secure adequate protection to the road surface) to have the wheel built up of several disks, more or less independent of one another, and with independent tires. These would have to be attached to the axle by some kind of adjuster so that the tire of each disk would carry a reasonable part of the total wheel load. Otherwise, undesirable concentration of wheel load would not be obviated by simply widening the tire. The construction of a wheel made up of several disks would be costly and might not be practical.

In the case of the pneumatic tire this adjustment is given automatically and very satisfactorily by the tire itself, although the pneumatic tire does have the unfortunate habit of picking up or chafing off the smaller

particles of the surfacing material of the road. This removal of the small particles of binding material is ordinarily assigned wholly to "suction," but it is probable that it is partly due to the lateral movement of certain parts of the lower elements of the pneumatic tire resulting from the temporary deformation of the tire under load, and this movement of the tire on the road is not entirely dissimilar to the movement of a rubber eraser on a piece of paper.

The "suction" does undoubtedly assist in the destruction of road surface by lifting up and transporting for a short distance the particles detached, so that they will not settle back into place. It seems, therefore, that merely increasing the width of tires will not give the desired protection; and it is suggested that the increase in the diameter of the wheel itself may accomplish a great deal more than a great increase in the width of the tire.

Some highway engineers have pointed out how the road metal is "hammered" by a heavy truck in order to bring out the effects produced by wheels of different diameters. It might be interesting if some one who has time to do so would compare the hammering effects of, let us say, a 24-in. wheel and a 72-in. wheel, both carrying the same load and moving at the same rate of speed when they strike an obstacle 3 in. high and having a vertical face toward the oncoming truck. Different cases may be assumed: (a) The wheel is without friction at the axle; (b) the wheel has friction of some assumed amount at the axle tending to cause the wheel to slide along the road; and (c) the wheel is a propelling wheel of a truck with some assumed rotative force applied to the axle.

The difference, if any, of the direction of the action lines of the hammering forces at the instant of impact developed by the two wheels, as well as the intensity of the forces themselves under the various assumptions, would prove interesting. The horizontal component of the hammering forces may be a large contributing cause to the destruction of roads by raveling out the surface and starting ruts and chuck holes. It might be well, also, to extend the investigation to include four-wheel vehicles, so as to bring out what effect on the road is produced by changes both in tread and in wheelbase.

It is probable that the four elements of design here referred to—width of tire, diameter of wheel, tread, and wheelbase—should all be held within certain practical maximum and minimum limits. On the other hand, it might be a good thing to require builders of vehicles designed for wholly different purposes to adopt different dimensions for the above elements, even including that of tread. In other words, vehicles should be arranged into classes according to size, purpose, weight, speed, etc., and certain maximum and minimum limits should be fixed for each class in the elements of design.

As to the use of steel tires versus solid-rubber tires, this is something that evidently needs very careful consideration. Perhaps an increase in wheel diameter, or some other change in design, may justify the retention of the steel tire. One of the important contributing causes to road destruction by a vehicle of given design is the product of load and speed, or the product of the load and some power of the speed. It is prob-

able that the roads can be conserved better by placing a speed limit on the trucks than by merely changing width of tire.

As to the use of trailers, it would seem that, everything else being equal, any increase in the tractive effort of a truck must increase the horizontal component of the force applied by the driving wheels to the road surface and must hasten destruction by raveling or grinding away that surface. If an overloaded locomotive can destroy heavy steel rails in a short time, it would seem that a road surface practically devoid of tensile strength must rut badly under the wheels of a heavy motor truck hauling heavy trailers.

In the present development of the motor truck hauling trailers, electric drive is not used; but if there is to be any great development of this form of transportation it would seem that in the interest of road maintenance it might be advisable to have some of the wheels of each vehicle apply the tractive effort needed for its own propulsion, and electric drive lends itself particularly well to this change.

The use of corrugations or projections on the tire may be necessary on unimproved roads or for what is practically cross-country work, especially on icy ground; but it would seem that their use on improved roads should be prevented. In case of ice, wheel chains could be used temporarily.

In view of the generally unsettled state of world politics it would be well for highway engineers to ascertain from the War Department the probable maximum military load before adopting highway regulations and bridge designs. It is understood that the present war in Europe is bringing out some new data on the subject. It would be unfortunate for the highway engineers of any section, particularly of New Jersey, to adopt such restrictive designs or regulations as would lead to the construction of roads and bridges wholly inadequate for military needs.

In summing up, it is suggested that road regulations should not be adopted without full consideration of the following points of design: (1) Width of tire, (2) diameter of wheel, (3) tread or length of axle, (4) wheelbase or length of vehicle, (5) character of tire, (6) use of trailers, (7) permissible speed, and (8) permissible wheel load and load of entire vehicle.

One thing seems certain: In the present state of highway improvement, as well as of motor-truck development, it behooves the motor-truck owner to be very careful to avoid unnecessary damage to improved roadways. If he is not, the development of good roads will be greatly retarded on account of the unforeseen and excessive cost of upkeep, and this will lead to the denial to motor-truck owners of the use of country roads.

The problems pertaining to the construction and maintenance of good roads are generally ignored by the public at the present time. It is quite the vogue to be enthusiastic over good roads without thinking much about the disagreeable subject of road maintenance. There seems to be a general air of blind hopefulness that the good road, once built, will somehow maintain itself. Until the public is thoroughly educated to the point where it will candidly face the serious questions of adequate maintenance of the good roads now built

or contemplated, it would be well for the motor-truck designers and owners to see that the motor truck is not made the scapegoat when the day of lamentation arrives.

W. L. GUTHRIE,

Major, Corps of Engineers, U. S. Army.
Mobile, Ala.

SIR: I have followed with a great deal of interest the numerous articles which have appeared in the *Engineering Record* in the past fifteen months on the regulation of motor traffic on streets and highways. Every highway and municipal engineer can cite numerous instances of practical destruction of certain classes of pavements by large motor trucks. In many cases pavements which have withstood ordinary traffic for years suddenly begin to fail when some temporary local condition routes a string of material trucks over them.

Fortunately, highway construction has practically just begun in the central states west of the Mississippi, and engineers will undoubtedly profit by the experience in the East and not build types of surfacing totally unsuited to any great amount of automobile traffic. There is a limit of endurance to every class of pavement, however, and there is no doubt that a few users of our pavements will, if unregulated, destroy large investments which would lend satisfactory service to the large majority if this abuse were not allowed.

Some regulation is also necessary to enable engineers to design economically for the future. All such laws should be based on three principles: First, they should be easily and equitably enforced; second, they should allow for natural industrial expansion, and third, they should be flexible enough to provide for changes in character of traffic and improvements looking toward the greater efficiency of this operation. New Jersey's law fails in all three of these respects. If it were possible at all to enforce many of its provisions the cost would be prohibitive and the results far from equitable. The speed governor and the provision for way bills of each load are thoroughly impracticable, as are a number of other provisions. Such requirements as rubber tires and only one trailer will handicap the development of freight hauling by motor trucks, instead of encouraging it as an economic benefit serving to decentralize our population and making a wealthier and more contented people.

In the third case, what would be the objection to a metal-tired wheel with a resilient hub and proper springs beneath the load, if a practical trailer of this kind should be placed upon the market? I believe that the proper way to regulate this class of traffic is to demand a license fee based upon the construction and capacity of the vehicle, making this fee on a sliding scale which would compel each vehicle to pay in accordance with the wear which it creates on the road surface. Vehicles over a liberal size and carrying capacity per wheel load should not be licensed, and in this connection it must be assumed that trucks will travel on the highway at times as fast as reasonable safety will permit. The provisions in the New Jersey law regarding size of wheel, width of tire and fee based on carrying capacity are sound and should be re-

tained, but I do not believe that they are liberal enough. A law should be framed to prevent unreasonable abuse without discouraging this class of traffic and the pavements built of a design and of materials which will withstand the heaviest expected regulated traffic.

CLARK R. MANDIGO,

Former Assistant City Engineer.

Kansas City, Mo.

How Soon Should the Surface of Concrete Roads Be Finished?

SIR: It is not the intention of the writer to advance any new idea, but rather to bring out an expression of opinion regarding the handling of concrete entering into a concrete road after it has left the mixer.

The methods of preparing the subgrade and the form of cross-section, crown, etc., seem to be pretty well established. Even the proportion entering into the mixture, which has been so widely discussed in the past, seems to be settled. But there remains one thing upon which engineers still differ—how shall the concrete be taken care of after it reaches the grade? Shall it be finished at once? Is the concrete better if some time elapses between striking and finishing?

The writer has noticed that many concrete roads lose a thin layer of surface shortly after being opened. The concrete below does not flake off like this top layer but “dusts” and does not seem to have the ability to resist wear although a strong mixture was used.

Some time ago a contractor who has put in a large number of concrete factory floors in Detroit stated that his success in building floors that do not “dust” is due to the fact that the concrete is finished immediately after being removed from the mixer. When asked if it wasn't hard to keep the finishers so close to the work, he stated that he considered this so important that the mixer was stopped if the finishers were getting behind until they caught up.

There is no question that some floors and concrete roads dust and ravel, and if immediate finishing is the solution of the former, why not of the latter?

The writer has often seen finishers working 75 ft. or more behind the mixer. Figuring that the gang lays 500 ft. per day, that means the concrete has been out of the mixer one and one-half hours. What is the effect when the finisher retempers the mortar in floating so long after it has been mixed? The initial set has been destroyed. Most specifications for concrete construction to-day call for the rejection of concrete that is not deposited in the forms within 30 minutes. The concrete road calls for more exacting specifications than building construction, for, in addition to shear, tension and compression, we have abrasion. We, therefore, should not be lax in road specifications. The finishers should not be more than 25 ft. behind the machine, if initial set is to be allowed to take place uninterrupted 30 minutes after mixing.

Some time ago an experiment was made to obtain a more even surface. A hand strike was sawed six times over a 25-ft. section of road, after which it was finished with a hand float. It looked beautiful to the eye—so even—but shortly after traffic was turned onto it a layer about $\frac{1}{8}$ in. in thickness came off, exposing the pebbles beneath. The exposed concrete was hard

through the tamping caused by the excessive striking, but the top layer which was continually disturbed by the strike lost its initial set and the bond to the lower material.

The chemical action of “setting” in the cement begins as soon as the cement comes in contact with the water. We should continue mixing the aggregates, cement and water up to a certain time, not to increase the chemical action, but to mix the ingredients thoroughly so as to get an even quality of concrete. It is found if we mix longer than this time we get a weaker quality of concrete. Why? Because we had it mixed and the continual turning of the drum is interfering with the setting.

Let us assume that we have turned it over in the mixer drum just the right length of time to get the strongest mix. We pour it out onto the grade, which is further mixing. Workingmen tramp into it, level it off and strike it, which is further mixing. Then after it has been out of the mixer an hour, along comes the finisher with a wooden float. He slushes the mortar top around in the excess water that has come to the surface, which is further mixing.

We have mixed the concrete in the drum until we have obtained the greatest efficiency out of the cement and then continued to mix or temper it, which experiments prove will decrease the efficiency. Then we come on and destroy the initial set by late floating. What is the result? Haven't you noticed the flakes that come off a concrete road soon after traffic is let on? That, together with continual dusting, is the result.

Many engineers agree that the concrete should be finished close to the mixer, and in order to do this easily they make the mixture very wet. The slushing of the excess water in the mortar with the float will not produce good concrete, to say nothing of the cement that has run to the sides with this water.

Mix your concrete dry by using the correct percentage of water. There will then be no excess water to evaporate and make voids in the concrete. It is true the striking, tamping and finishing of such concrete will cost more than the sloppy kind, but the wearing surface produced is worth ten times the cost.

Concrete roads will last indefinitely if destroyed through wear alone. Raveling is what destroys them, and that takes place when the hardness of the mortar is not on a par with the coarser aggregate and allows it to loosen and be picked out.

Mix your concrete the proper time, deposit it on the grade, crown and float it at the earliest possible moment, and let nature do its work uninterrupted.

EDWARD N. HINES,

Chairman, Board of County Road Commission, Wayne County (Detroit), Michigan.
Detroit.

Dish Concrete Roads on Grades

On concrete roads in the vicinity of Sioux City, Iowa, where 20 miles of 16-ft. width have been laid recently, the crown is eliminated on grades of 4 per cent and over, according to the *Iowa Service Bulletin*. The idea is to carry away the water rapidly and still not wash in the dirt shoulders and side ditches. At the foot of the hill a concrete runway carries the water off the roadway into the side ditch.

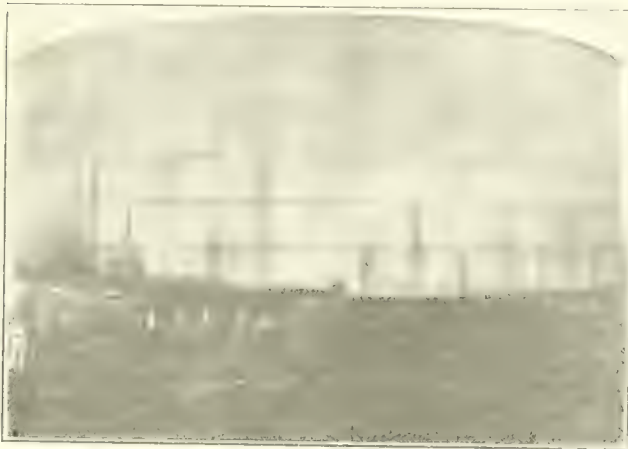
HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

CONTRIBUTIONS to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.

Ninety-Foot Diameter Oil Tank Moved Fourteen Miles on Pair of Barges

AN UNWIELDY oil tank, shown in the photograph, 30 ft. high and 90 ft. in diameter and weighing 120 tons, was recently moved intact on two barges 14 miles by water from Seattle, Wash., to Point Wells. On account of its large diameter, the two barges on which it was loaded, each of which was 34 x 90 ft., were spaced



NINETY-FOOT DIAMETER TANK LOADED ON TWO BARGES AND MOVED FOURTEEN MILES

16 ft. apart, and lashed to timbers lying across both decks.

To raise the tank, which rested on a brick foundation level with the ground, four tunnels were driven from the circumference to the center, in which temporary timbers and jacks were placed, in addition to 30 jacks under the outside ring. The tank was raised in this way 4 ft. until six 12 x 14-in. cross-timbers running from side to side and two 16 x 18-in. running timbers at right angles to them, and symmetrically located 50 ft. apart, could be placed. The runways under these

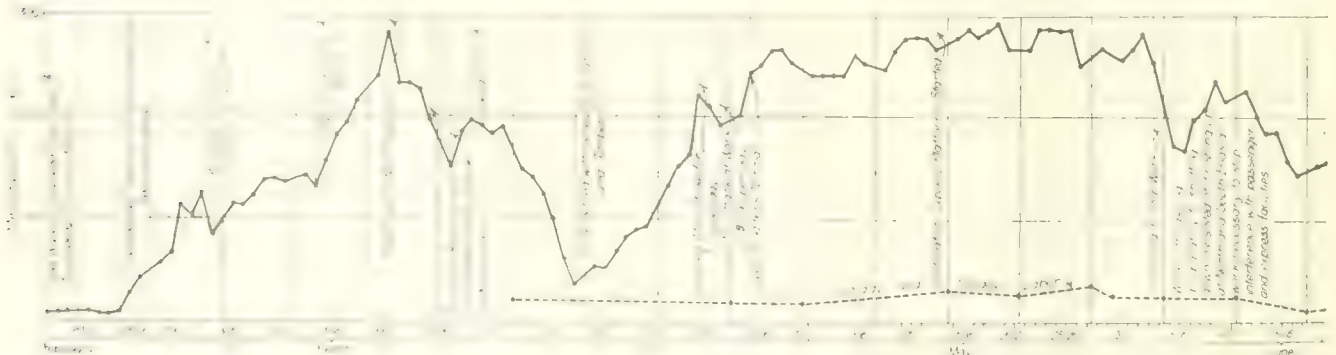
stringers were each made of three 6 x 6-in. timbers, placed on 6 x 6-in. blocking. The tank was moved about 800 ft. on these runways, using sixty 8-in. maple rollers, by a team of horses and a capstan. The track extended over the deck of the scows, and was arranged so that the section on the scows was level with that on shore at high tide. The tank was started on to the scows about 1 hour before high tide, so as to have ample time for loading before the tide receded too far.

The tank was towed to Point Wells by a tug, where the loading operation was reversed, the tank being taken off at high tide and moved about 300 ft. to new foundations.

The tank, which belongs to the Standard Oil Company, has a capacity of 1,424,270 gal. It required Olson & Nicholson, contractors, of Seattle, about 30 days to move it, and 75,000 ft. b.m. of timber was used for blocking.

Labor and Progress Charts Give Good Construction Record

THE CHARTS reproduced herewith show the close relation between the labor supply and the progress of the work during the construction of the concrete slab, built by the Long Island Railroad to safeguard its Flatbush Avenue terminal during future subway construction, and described on page 52 of this issue. The curve on the labor chart shows the number of men employed each day, and the progress chart indicates the expected progress outlined at the beginning of the work and the actual dates on which the different operations were carried out. Both show the slow start due to the difficulty of gathering an organization in the depleted labor market of New York City last winter. The serious delay to the work resulting a short time later from the strike of the subway laborers is plainly marked in the progress chart, while the actual reduction in the force is shown on the labor chart. When, after the work had recovered from the effects of the strike, it was deemed advisable by the Long Island Railroad to shut down work for a brief period, the labor chart plainly shows that the men laid off could not be replaced, and the effect of the reduced force with which it was neces-



FLUCTUATIONS IN NUMBER OF MEN EMPLOYED, SHOWN IN LABOR CHART BELOW FOR ENTIRE JOB, REFLECTED IN

sary to complete the work is shown in the flattening out of the progress curves.

Needless to say, records of this kind are invaluable on much construction work, especially when it is of the rush order. The charts were made by James Forgie, who carried out the work as consulting and construction engineer in charge of a special organization for the Long Island Railroad Company.

Reach of Dredge Increased by Supporting Bank Spud on Log Bridge

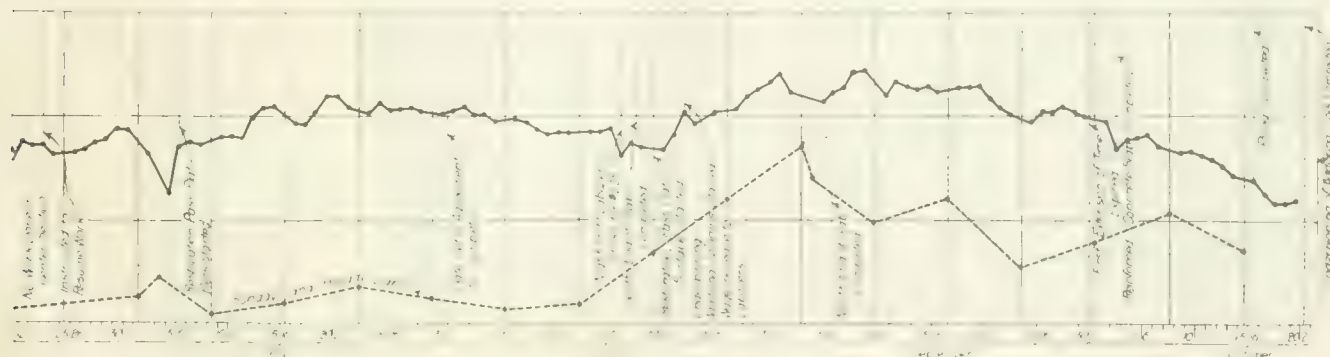
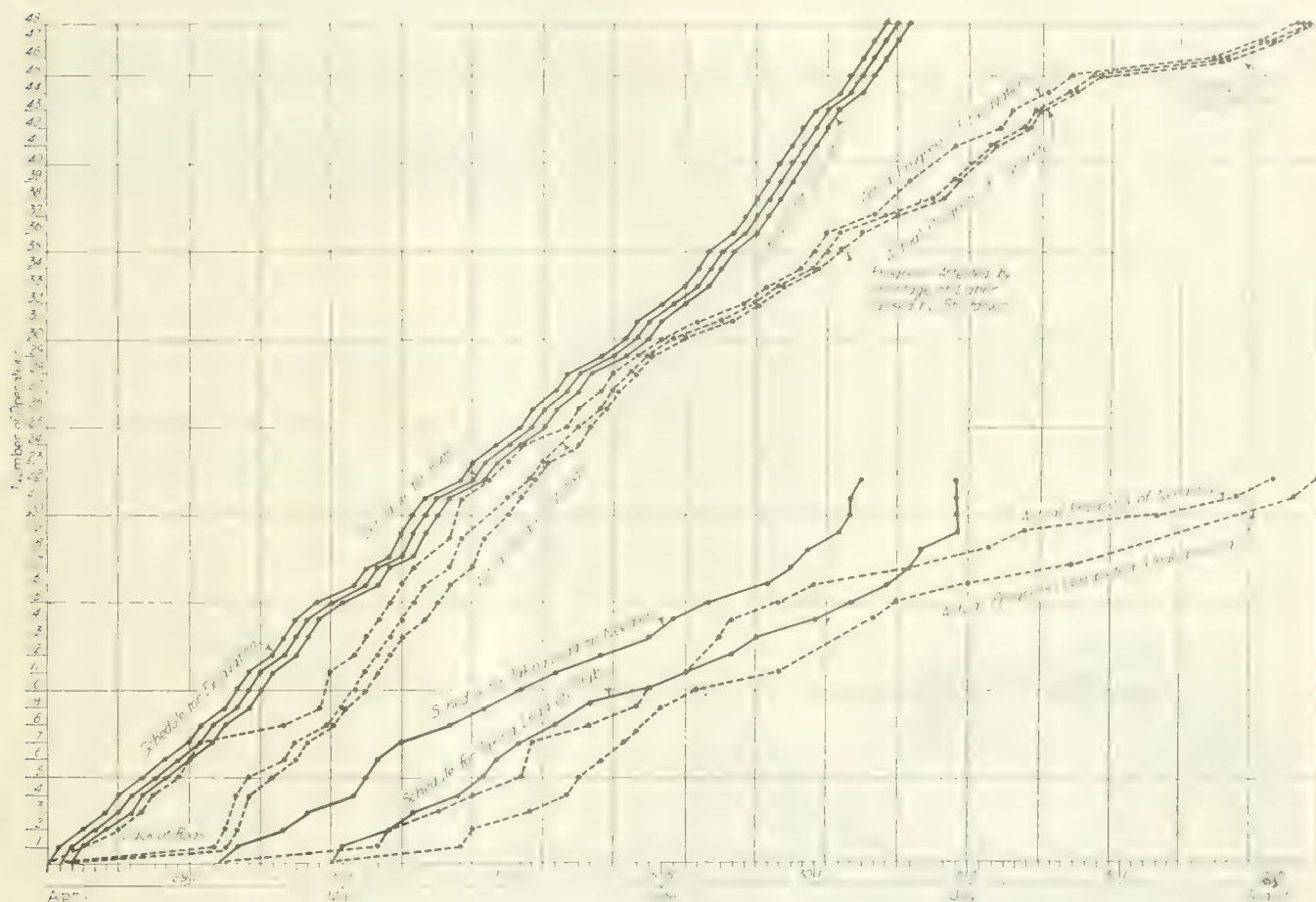
By RALPH BOSARD

Morgan Engineering Company, Memphis, Tenn.

IN EXCAVATING a ditch on drainage work in Tennessee with a dredge which could not deposit material at the desired distance while stationed in the center of the cut, and the bank spuds of which did not

have sufficient spread to permit of taking the cut out in halves, the necessity for lengthening the boom and thus overstressing the dredge was avoided by using a log bridge from the deck of the dredge to the bank to support the spud on one side in making the second cut.

The work done on this drainage contract consisted of digging two laterals and a main ditch, the three having a total length of about 16 miles. The ditches are located in west Tennessee, about 15 miles north of Dyersburg, in what is known as the Reeds Creek Drainage District. The two laterals were of minimum size, having 14 ft. bottom width and $\frac{1}{2}$ to 1 side slopes. The main ditch was specified to be of minimum size for the first $3\frac{1}{2}$ miles, while for the next 2 miles a bottom width of 25 ft. with 1 to 1 side slope was required, and for the remaining $3\frac{1}{2}$ miles a bottom width of 35 ft. with 1 to 1 side slopes and a depth of 10 ft. This made the top width 55 ft. The width of berm specified was 10 ft. on each side for this as well as for the other sections.



RATE OF COMPLETING WORK, PARTLY SHOWN IN CHART ABOVE FOR PROGRESS OF SOUTH HALF OF CONCRETE SLAB

The equipment installed by the contractor, a 1½-yd. dipper dredge with a 55-ft. boom mounted on a 30-ft. hull, readily handled all the material until the wide section at the lower end of the ditch was reached. Here it was not possible for the dredge to dispose of the waste material while in the center of the ditch. It was likewise impossible to shift the dredge from side to side and take the ditch out in halves, because the spuds did not span a sufficient width for excavating the second half. To increase the length of the boom would have overloaded the entire dredge and brought in excessive repair bills. Instead, the method shown in the photograph, of increasing the effective reach of the spuds, was devised.

This was done by bolting logs 22 ft. long, with a minimum diameter of 15 in., to the lower end of one spud. The logs were placed parallel, one on each side of the jack arms, resting at one end on the hull and at the other on the bank. The outer end of the logs, extending some 7 or 8 ft. past the spud foot, were tied together on the top and bottom by 6 x 8-in. timbers. Two timbers of the same size were butted up against each side of the spud foot and bolted to the logs. This arrangement allowed the operator to disengage the spud and place it in the ditch if desired.

In operation, the dredge was taken down one side of the ditch a distance of about half a mile, moving about half of the material in the section and placing all of it on the waste bank on that side. The dredge was then brought back to the beginning of the cut and the logs bolted to the spud next the first-deposited waste bank. With the lengthened spud on that side of the dredge, it was possible to set the dredge over to the other side of the ditch and dig it out, leaving the required width of berm. The time required to attach the logs was only a few minutes. Their use accomplished the same results as the installation of a new boom from 20 to 25 ft. longer than the old one.

R. H. & G. A. McWilliams were contractors for the section described.

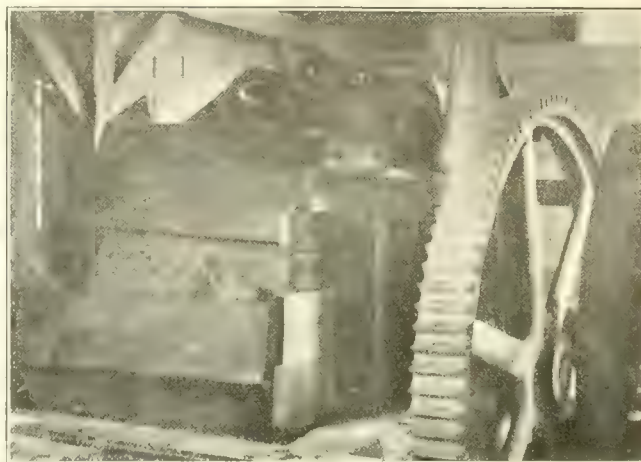


LOG BRIDGE SUPPORTING LOWER END OF SPUD ENABLED DREDGE TO DIG WIDE SECTION AND LEAVE REQUIRED 10-FOOT BERM AT SIDE

Cast Concrete Pulley Made When Cast-Iron One Breaks

By H. S. CARPENTER
Cobleskill, N. Y.

A BROKEN cast-iron pulley was recently repaired in the course of the writer's work by pouring it full of concrete. The pulley, which is one of the pair carrying the main elevator in a large stone-crushing plant, is 54 in. in diameter with a 20-in. face. In the failure,



CAST-IRON PULLEY TURNED INTO CAST CONCRETE

nearly the entire rim was broken out. An extra pulley was not available, and it took some time to secure a new one. To avoid shutting down the plant in the meantime, a form was built in place around the remains of the old pulley, using perforated metal faced with building paper for the rim and wood for the sides. The belt was left in place and the whole interior of the form poured full of 1:2:3 concrete. The upper part of the form, partly removed, is shown in the photograph.

Pouring was finished at 6 p. m. on Saturday and the concrete pulley was put in service at 11 a. m. the following Monday. The job was a complete success. The belt runs directly on the concrete.

To Relieve Counties of Road Maintenance

When a county road has been brought to the required width, grade and finish, it can be turned over to the state and thereafter the county will not have to expend money on its maintenance. The sooner a county road is developed, the sooner it can be taken over by the state and the county relieved of further expense. That is the feature of the proposed legislation which will be introduced in the Oregon state legislature at its next session.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Consider Adoption of Pennsylvania Water Policy

Will Do Nothing Until Well-Ordered Plan Is Completed—Conservation Would Cost \$100,000,000

First steps toward adopting a comprehensive and logical policy of water conservation for Pennsylvania were taken Jan. 3 when the first meeting of the Governor's Flood Control Committee was held in the office of Dr. Samuel G. Dixon, health commissioner. It was announced that an expert had estimated that if the state attempted to conserve all its waters and provide measures to control the floods of its 45,000 square miles of territory, as much as \$100,000,000 would be required.

It was decided to ask for an appropriation of \$50,000 to meet an equal amount furnished by the United States government toward the completion of the topographical and geographical survey of the state. In addition to this, and to supplement it, the committee will have drafted by its counsel a bill which provides for making a comprehensive survey of all the waters of the state. Upon this will be based a plan for the administration of the state's water resources. An appropriation of \$200,000 will be requested with which to make the stream survey, which will be put under the control of the water-supply commission.

Will Not Rush Work

It is the unanimous opinion of the members that every effort should be made to avoid the mistake of rushing into water conservation legislation before a logical plan had been developed which would meet all conditions in the state.

"What we want to emphasize," said Dr. Dixon, "is that we are seeking a well-thought-out plan and that we hope not to take any step before we have the whole well-ordered scheme in view. It will take probably at least two years to make the detailed observations we need. That will provide a map showing location, condition, improvements, present use and legal status of the streams throughout the state, as well as other things necessary for the studies. This would also include such things as floods and we will know where they are likely to occur and how best to prevent the formation of conditions that lead to them."

Among the members who attended were Hon. Gifford Pinchot, Dr. Henry S. Drinker, Deputy Attorney-General Keller, John B. Eichenauer, George S. Webster, S. B. Elliott, J. A. Walls, E. W. Walker and Morris Knowles.

Hugh M. Wilson

Retires as Vice-President of McGraw Publishing Company Inc.

Hugh M. Wilson, first vice-president of the McGraw Publishing Company Inc., has tendered his resignation and will devote himself to his personal interests. Mr. Wilson has been vice-president of the company for the last six years. During that period the organization has grown constantly to greater strength. Two new papers, *Electrical Merchandising* and *The Contractor*, have been purchased, *Metal-*



HUGH M. WILSON

urgical & Chemical Engineering has been changed from a monthly to a semi-monthly, while the other properties, *Electrical World*, *Electric Railway Journal* and, notably, the *Engineering Record*, have made rapid progress.

Mr. Wilson has been in journalistic work during practically his entire business life. His first experience was as city editor of the *Jacksonville (Ill.) Daily Journal*. He subsequently was reporter on the *Minneapolis Evening Star*, but in 1889 made the change that determined his career. He joined the staff of the *Mississippi Valley Lumberman*, and with but one brief interruption since, has devoted his great energy and abilities to the one object of developing magazines in trade and technical lines. His progress with the *Lumberman* was rapid, but he soon changed his desk for another—this one in the office of the *Northwestern Railroader*, beginning then his connection with a field that came in a very few years to recognize him as one of its great leaders. He entered the staff as asso-

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Saville Heads New England Waterworks Association

Chief Engineer of Hartford Water Department Elected President at Annual Meeting This Week

Caleb Mills Saville, who was elected president of the New England Waterworks Association at the annual meeting in Boston Jan. 10, was born in Melrose, Mass. He was graduated from Harvard College in 1889 with the degree of A.B. and a *cum laude* in engineering.

In 1890-91 he was assistant to M. M. Tidd, civil and hydraulic engineer, of Boston, and engaged on construction work on the Simpson drydock in Boston and on the design and construction of waterworks systems in various parts of the United States.

In 1891-95 he was engineer in charge of design and construction of the sewerage system in Malden, Mass. From 1895 to 1906 Mr. Saville was division engineer in the distribution department of the Metropolitan Water and Sewerage Board of Boston, having charge of numerous construction works of considerable magnitude, among which were the work incidental to building a storage reservoir at Spot Pond, the construction of the Forbes Hill reservoir, the driving of a tunnel under the Mystic River, and much work in connection with operation and maintenance.

Was on Panama Canal

In 1906-7 he was hydraulic engineer with French & Bryant, of Brookline, Mass., having in charge studies for several waterworks developments. From 1907 to 1912 Mr. Saville was connected with the Panama Canal, first as assistant division engineer in charge of construction work at Gatun. He made investigations for foundations and methods of construction for the Isthmian Canal dams, and later was appointed engineer in charge of the third division, office of the chief engineer. He made an unusually comprehensive study for the foundations of the Gatun dam. In his book, "The Panama Canal," F. J. Haskins states: The engineer who worked out the details of the engineering examinations of the Gatun dam in 1908 was Caleb M. Saville, who had had experience on some of the greatest dams in the world. Every engineer who has read Saville's report pronounces it a masterpiece of engineering investigation."

While in charge of the third division at Panama Mr. Saville had under his direction the hydrographic and meteorological work, general surveys and special investigations. For his paper on "The Hydrology of the Panama Canal"

he was awarded the Norman medal (1914) of the American Society of Civil Engineers.

In 1912 Mr. Saville resigned from the Panama Canal, having been invited by the Hartford (Conn.) Water Board to become its chief engineer, to take charge of its maintenance and operation work as well as the construction of the new additional supply. The latter work consists of the building of three large dams and reservoirs, eight miles of conduit, $\frac{1}{2}$ mile of rock tunnel, and an extensive filtration plant.

The following vice-presidents were elected: Carleton E. Davis, chief of the Philadelphia bureau of water; Samuel

Elected President of New England Waterworks Association



CALEB MILLS SAVILLE

E. Killam, superintendent of pipe lines and reservoirs, Boston; Henry V. Macksey, superintendent of public works, Woburn, Mass.; Frank A. Barbour, consulting engineer, Boston; Percy R. Sanders, superintendent of waterworks, Concord, N. H., and Thomas McKenzie, superintendent of waterworks, West-

chester, N. H. Willard Kent, of Narragansett Pier, R. I., was elected secretary; Lewis M. Bancroft, superintendent of waterworks, Reading, Mass., treasurer; Richard K. Hale, of Brookline, Mass., was made editor. The executive committee are William F. Sullivan, Frank J. Gif-

Hearing on First Government Valuations Set for January 29

Monday, Jan. 29, has been fixed by the Interstate Commerce Commission as the date for the hearing on the valuations of the Atlanta, Birmingham & Atlantic Railway and subsidiaries, and the Texas Midland Railroad. The hearing will be held at Washington.

Hugh M. Wilson

(Continued from page 79)

ciate editor, but his business experience, the result of early training in his father's planing mill at Jacksonville, Ill., made him a valued adviser on the financial affairs of the paper. So keen was his business sense that when, within a year of his association with the *Northwestern Railroader*, it was consolidated with the *Railway Age*, at Chicago, he was made secretary-treasurer of the new organization.

Again his dual training—in business affairs and in editorial work—showed itself, for while he had a heavy load of business responsibilities, he found time to do much editorial work, particularly on news matters relating to the purchase of equipment and supplies. His familiarity with this branch of railroad work soon made him an authority and fitted him for the yeoman work he did as secretary of the Railway Supply Manufacturers' Association, which position he held from 1893 to 1897 inclusive. He subsequently became manager of the *Railway Age*, meanwhile continuing as secretary-treasurer. He was elected president of the company in 1899.

His tireless energy, vision and editorial grasp were never better displayed than by the publication during the International Railway Congress at Washington, in 1905, of a daily edition of the *Railway Age*, which was designated as the official journal of the congress. Supplementing the praise showered on him by both American and foreign delegates for the success of this enterprise, he was created a chevalier of the Order of Leopold by the King of the Belgians.

In 1906 the Wilson Company, with Mr. Wilson as the controlling owner, was organized, taking over the publication of the *Railway Age* and of the *Electric Railway Review*, which had just then been purchased and which was changed shortly from a monthly to a weekly publication.

Two years later Mr. Wilson sold both papers. The *Railway Age* was consolidated with the *Railroad Gazette*, while the McGraw Publishing Company purchased the *Electric Railway Review* and consolidated it with the *Street Railway Journal* under the name of the *Electric Railway Journal*.

Mr. Wilson immediately went abroad for an extended trip, and on his return in June, 1909, was elected director and vice-president of the Barney & Smith Car Company of Dayton, Ohio. His return was made the occasion of an elaborate dinner in his honor by the railway supply manufacturers and the presentation to him of a memorial setting forth the value of his services to the railroad industry during his presidency and editorship of the *Railway Age*.

Mr. Wilson continued with the Barney & Smith Car Company until 1910, and was then elected first vice-president of the McGraw Publishing Company, which position he now relinquishes. Mr. Wilson's strength as a publisher

and his success in building up strong technical magazines have been due to his ability to sense the trend of events and to keep before him meanwhile certain clear ideals as to the place of the magazine in its industry or profession. He never faltered in his presentation of the truth, when the speaking of the truth was timely and would be productive of good. Frequently that course offended powerful interests, who were unable to see, as he saw it, that the ultimate good of all could be served only by such a course. But that never caused him to hesitate. His influence not only on the journals with which he was connected but on the whole field of trade and technical journalism will be a lasting one.

Mr. Wilson's home address is Hartsdale, N. Y.

Illinois Highway Superintendents Meet January 18 and 19

The annual meeting of the Illinois Association of County Superintendents of Highways will be held Jan. 18 and 19 at the University of Illinois. The first day will be devoted to election of officers, the second to new business. Amendments to the Tice law will probably be suggested. The short courses in highway engineering will also be held on these dates.

Forest Money Allotted

Allotment to the various states of the \$1,000,000 to be spent in the next fiscal year in constructing roads and trails in national forests was announced Jan. 6 by the Secretary of Agriculture as follows:

Alaska, \$46,354; Arizona, \$48,604; Arkansas, \$9,803; California, \$140,988; Colorado, \$62,575; Idaho, \$108,730; Montana, \$7,042; Nevada, \$19,296; New Mexico, \$42,495; Oregon, \$128,111; South Dakota, \$8,092; Utah, \$41,167; Washington, \$91,904; Wyoming, \$40,684, and a total of \$9,995 to Florida, Michigan, Minnesota, Nebraska, North Dakota and Oklahoma.

Ohio River Bridge Must Be Reconstructed

The Supreme Court on Jan. 8 sustained the previous decision of the U. S. District Court requiring the Louisville Bridge Company at its own expense to reconstruct the Ohio River bridge at Ohio Falls in accordance with the ruling of the War Department. The injunction prohibiting reconstruction, which has been underway for some months, from proceeding except as required by the government order, was affirmed. The bridge must therefore be rebuilt with a clear channel span of 600 ft. over the "Indiana Chute," and the existing swing span across the Louisville and Portland Canal must be changed to a lift span giving horizontal clearance of 200 ft. and vertical clearance of 78 ft. The estimated cost is given as \$400,000. The requirement was upheld as within federal authority under police power to prevent unreasonable obstruction to free navigation.

Western Society Honors George Washington as an Engineer

Honor to George Washington as an engineer is the idea of the Western Society of Engineers in naming the award founded by John W. Alvord for promoting the public good "the Washington award." Many structures still exist which the first President built as an engineer, and as he was pre-eminently devoted to promoting the public good the appropriateness of the title should be apparent, said B. E. Grant, the retiring president of the society at the annual meeting and dinner, held Jan. 10, in announcing the terms of the award.

Professional unity is to receive one more boost because of this award, for the membership of the committee is not to be restricted to the one society. The national societies of civil, mechanical, electrical and mining engineers have been asked to select two members each to act with nine from the Western Society of Engineers. A large membership was chosen for the purpose of keeping in touch with the widest possible range of engineering activities.

The Chanute medals for the best papers by members were awarded to Col. C. McD. Townsend, Corps of Engineers U. S. A., for a paper on "Currents of Lake Michigan and Their Influence on the Climate of the Adjoining States," and to Wilbur M. Wilson, assistant professor of structural engineering, University of Illinois, for a paper on "Wind Stresses in Steel-Frame Office Buildings."

The sensation of the evening was a mock trial of one Arthur J. Hennebik, charged with practising structural engineering without a license in that he designed a certain mausoleum in violation of the state law. The sketch was written by Benjamin Wilk.

An excursion provided by the Illinois Central Railroad was made Jan. 11 to the Pullman car works and the Illinois Steel Company's plant.

The results of the election of officers are as follows: President, H. J. Burt; vice-presidents, D. W. Roper, J. N. Hatch and W. W. DeBerard; treasurer, C. R. Dart, and trustee, O. F. Dahlstrom.

Reclamation Engineers Will Convene January 22

U. S. Reclamation Service engineers from the operation and maintenance departments of the Rio Grande, Hondo and Carlsbad projects in New Mexico, the Salt River valley and Yuma projects in Arizona, and the private irrigation projects of southern California, will meet Jan. 22, 23 and 24 at Phoenix, Ariz., for the annual conference on maintenance and operation problems. Special emphasis will be placed on the subjects of drainage and cleaning of canals. One of the three days will be devoted to an inspection of the Salt River project, and possibly the meeting will conclude with a trip to the Roosevelt dam.

Washington Residents Must Use Water or Lose It

Projected Legislation Would Terminate Friction Between Riparian-Rights People and Users

A bill to eliminate the long conflict between water users and those who have insisted upon full riparian rights in the state of Washington, in the sense of acquiring rights in a stream and preventing its use, is now being circulated among newspapers, interested citizens and public officials. The keynote of the bill is that a man must use the water to which he claims a right in order to retain that right. Use is held to be the essence of the property owner's right in a stream, and this he will ultimately lose if he does not use the water. If enacted into law, the bill will prevent acquisition of a riparian right and holding it purely for speculation.

Creates State Hydraulic Engineer

This water code was adopted by the Water Code Conference called by Governor Lister at Tacoma, July 11 and 12, 1916, and adjourned to North Yakima Nov. 15, 1916. The principal contest in the conference was between the riparian-rights representatives and the irrigationists. This conflict is disposed of by the water code, which fixes a limit of time within which a person claiming riparian rights must exercise them. The code provides for a state hydraulic engineer and gives him liberal authority to settle water controversies. All applicants for water rights must apply to the state hydraulic engineer.

O. L. Waller, professor of mathematics and civil engineering at the State College of Washington, is chairman of the water code committee.

President Would End "Pork"

President Wilson, in a conference Jan. 3 with Chairman Sparkman of the House Rivers and Harbors Committee, said he was opposed to the present method of appropriations and believed expenditures of that nature should be administered by commissions. Chairman Sparkman promised to include in the Rivers and Harbors bill of the present session a provision for creating such a commission. It is thought that the President will also insist upon a commission to administer funds for public buildings.

The President said that he desired to systematize the appropriations for rivers and harbors, flood control, irrigation and reclamation. This could best be done, he thought, through a commission which would thoroughly study the problems and work out a system under which present haphazard methods of appropriation would not prevail. The President's plan will deprive Congress of its time-honored privilege of designating particular improvements.

McGraw Company Buys Two Contracting Papers

Consolidated Publication Will Be Issued at Chicago Under Direction of Engineering Record Staff

The McGraw Publishing Company Inc. has purchased the *Contractor* and the *Contractor's Review*, both of Chicago, and will consolidate them under the name of the *Contractor*.

The new paper will continue to devote itself to the interests of the contractor engaged chiefly in local work and of the contractor's superintendent. It will be published at Chicago every other week, and the subscription price will be \$1 a year.

The editorial and advertising policies will be directed by the staff of the *Engineering Record*, with E. J. Mehren, editor of the *Engineering Record*, as editorial director and C. S. Hill as acting editor. Mr. Hill has been the editor of the *Contractor's Review* and was formerly managing editor of *Engineering and Contracting* and associate editor of *Engineering News*.

Niagara Water Bill Passed

The House on Jan. 4 passed the Wadsworth bill, authorizing the Secretary of War to grant to waterpower users the entire 20,000 sec.-ft. of water divertible by the United States from the Niagara River under a Canadian treaty. The bill has passed the Senate and will go to conference so the amendments may be straightened out.

New Smoke Ordinance for Denver

A new smoke ordinance under consideration in Denver provides for the appointment by the Mayor of a commission of five members, three of whom would be engineers. The commission would act in an advisory capacity to the smoke inspector, obtain the co-operation of property owners, make rules and regulations for smoke inspection, and pass upon all applications for the installation or remodeling of power or heating apparatus. Penalties are provided for smoke of greater density than that specified. It also provides for a deputy smoke inspector at \$2,400 per year, who shall have a technical training.

The report, of which the ordinance is the result, is the work of the smoke-abatement committee of the Denver Civic and Commercial Association. Frank E. Shepard is chairman. The other members are C. S. Pearce, Henry Read, Lewis Skinner and W. W. Case, Jr.

Want Topographer in Seattle

A topographical engineer is wanted by the Seattle school board to lay out school grounds and make the necessary elevations for all new school buildings, so that they will comply with aesthetic standards. The engineer selected will rank as consulting assistant to the school architect.

Henry Goldmark Made Member of Canal Board

Succeeds to Office on New York Barge Canal Made Vacant by Death of Dr. Corthell

Henry Goldmark, consulting engineer, of New York City, was recently appointed a member of the board of consulting engineers for the New York Barge Canal. His appointment fills the vacancy caused by the death of Dr. Elmer L. Corthell. Mr. Goldmark has

Appointed to Succeed Dr. Corthell on Barge Canal Board



HENRY GOLDMARK

engaged in private practice in New York since 1914, at which time he resigned as designing engineer for the Isthmian Canal Commission. Among his recent undertakings is the design of equipment for a dock at Chemulpo, Korea, an article on which appeared in the Engineering Record of Dec. 12, 1916, page 684.

After graduation from Harvard University in 1878, Mr. Goldmark spent two years studying at the Royal Polytechnic Institute at Hanover, Germany. His first engineering work was on the Erie Railroad in 1880. From 1882 to 1896 he was engaged mainly on bridge construction for various railroads. During 1882 and 1883 Mr. Goldmark was engineer in the bridge department of the West Shore Railroad under Albert Lucius, and from 1887 to 1891 engineer of bridges for the Kansas City, Fort Scott & Memphis system. He also made special reports on all existing bridges for various railroads, including the Boston & Maine and branches of the Santa Fe system. His efforts in 1892 and 1893 were devoted to designs of World's Fair buildings at Chicago, and much miscellaneous work.

The Pioneer Power Plant of Utah,

one of the very first of the large hydro-electric installations in the United States, was designed by Mr. Goldmark in 1896 and 1897. He also made plans for the late George S. Morison of the large concrete viaduct which carries Connecticut Avenue over the Rock Creek Valley at Washington, D. C. The years 1897 to 1900 he spent in charge of lock-gate design for the U. S. board of engineers for deep waterways, including what was considered by the late Alfred Noble the most complete general study of lock-gate design that has yet been made.

In 1901 Mr. Goldmark was made resident engineer for George S. Morison on the erection of a railroad bridge across the Missouri River at Atchison, Kan. This was the last work of that noted engineer. For the next five years Mr. Goldmark was engineer in charge of the design and construction of the large locomotive and car shops for the Canadian Pacific Railway at Montreal and Winnipeg, and of the new works of the Canadian Locomotive Company at Kingston.

From 1906 until 1914 he was designing engineer for the Isthmian Canal Commission in charge of the plans and construction of the lock gates, chain fenders, caissons, a floating railroad bridge and various other works on the Panama Canal.

Cable Supporting Concrete Chute Parts, Toppling Two Towers

A 1-in. cable supporting a concrete chute became so badly worn at the point where it passed over the oak support that it parted Jan. 2 and caused the collapse of a chute and two concrete towers being used in the construction of a building for the American Can Company at Maywood, Ill.

At first it was thought that the accident was due to a defective cable, but close examination, state the contractors, indicates that the cable was worn through where it passed over a 4 x 12 in. oak head block at the top of the concrete tower. Subsequent tests showed the cable was able to withstand twelve times the load carried. The chute fell across guys for this tower, which, in toppling over, fell on guys supporting a tall 210 ft. tower. The tall tower did not fall full length, but collapsed vertically, the guys holding it in this position.

Announce Nominees for American Concrete Institute Offices

The nominees for office in the American Concrete Institute are as follows: President, Prof. W. K. Hatt, of Purdue University; vice-president, Sanford E. Thompson, consulting engineer, Boston; treasurer, Robert W. Lesley of Philadelphia. The nominees for directors are: Ernest Ashton, chemical engineer, Lehigh Portland Cement Company; W. P. Anderson, president, Ferro-Concrete Construction Company, and E. M. McCullough, chief engineer, fireproof construction bureau, Portland Cement Association.

Engineering Society Activities

Municipal Engineers of the City of New York will hold their annual meeting Jan. 24 in the Engineering Societies Building. After a short business session there will be musical numbers and a dance. Admission will be by card only.

Engineers' Society of Western Pennsylvania met Jan. 9 to hear Horace R. Thayer, assistant professor of structural design, Carnegie Institute of Technology, tell of historic failures of masonry structures.

Associated Technical Societies of Baltimore has been formed to effect "a closer relation between the various organized bodies of technical men." The initial membership is about 500.

Engineers' Club of Cincinnati has elected the following officers for the ensuing year: Prof. A. M. Wilson, University of Cincinnati, president; A. E. Robinson, superintendent of the American Tool Works Company, vice-president; E. A. Gast, Hamilton County bridge engineer, secretary and treasurer; directors, E. A. Muller, mechanical engineer of the King Machine Tool Company, O. F. Shepard, Jr., electrical engineer, Warner Elevator Company, and Prof. G. M. Brown, of the University of Cincinnati.

Indiana Engineering Society will hold its annual convention Jan. 18, 19 and 20 at Purdue University. At the first session, beginning in the afternoon, Prof. F. H. Newell and Gen. Anson Mills are scheduled for addresses. The banquet is to be held Friday evening; municipal engineering subjects will be discussed Saturday morning.

Colorado Association of Members of the American Society of Civil Engineers will hear this evening M. S. Ketchum, dean of the College of Engineering, University of Colorado, discuss "The Design of Highway Bridges." Recent practice is to be outlined of live loads, types of structures, bridge floors and width of roadways.

North Dakota Society of Engineers will hold its annual convention Jan. 30 and 31 at Bismarck. F. E. Chandler, secretary, states that practically every kind of engineering, from mining to municipal, is to be covered.

Iowa County Engineers' road school and convention will be held at Ames Feb. 27, 28 and March 1. The formal program will be brief, most of the time being available for discussion.

Oklahoma Society of Engineers at its annual meeting Dec. 27 and 28 elected the following officers: President, Alfred Boyd, dean of engineering, A. & M. College; vice-presidents, Max L. Cunningham, state engineer; Frank B. King, U. S. Corps of Engineers, and T. P. Clonts, county engineer, Muskogee; secretary-treasurer, H. V. Hinckley, consulting engineer, Oklahoma City.

Lieut.-Col. Chester Harding New Governor of Panama

Has Been Acting Governor in Absence
of General Goethals—On Canal
Work Since Late in 1914

Lieut.-Col. Chester Harding, Corps of Engineers, U. S. A., who was in 1914 appointed engineer of maintenance of the Panama Canal, has been made governor of the Panama Canal Zone to succeed General Goethals. The appointment, made by President Wilson, will probably be approved by the Senate soon. During the last few years Colonel Harding has been receiving training and experience that would fit him for the office for which he has been selected. In the absence of General Goethals he has been acting governor.

Chester Harding was born in 1866 at Enterprise, Miss. He was graduated from the University of Alabama in 1884 and from the U. S. Military Academy in 1889. After three years in the graduate school at Willets Point, N. Y., he was sent to Chicago to work

Has Been Appointed Governor of
Panama Canal



Photo by Harris & Ewing, Washington
LIEUT.-COL. CHESTER HARDING

on river and harbor improvements. That was followed in 1894 by his appointment to duty on the Mississippi River. After two years on that work Colonel Harding was made instructor at the Military Academy. He was advanced to the rank of captain in 1898 and put in charge of the torpedo defense of Narragansett Bay. The following year he was transferred to duty on the shores of Lake Michigan.

His appointment as assistant to the engineer commission of the District of Columbia, in charge of the sewer, water and building departments, came in 1901.

In 1906 he was made a major, and later in that year was appointed engineer commissioner of the district. Late in 1914 Colonel Harding was transferred to the Panama Canal as engineer of maintenance in the permanent government of the Canal Zone.

What Engineers and Contractors Are Doing

RICHARD R. ROSE has resigned as estimator for the Ferguson Steel & Iron Company, of Buffalo, to join the forces of the Riter-Conley Manufacturing Company at Pittsburgh. Mr. Rose is a graduate of the School of Architecture at Carnegie Institute of Technology.

HENRY WELLES DURHAM recently resigned as county engineer of Bergen County, New Jersey, and will devote all of his time to his private practice at 366 Fifth Avenue, New York City. Mr. Durham was appointed county engineer in January, 1916. He has been carrying on consulting practice since June, 1915, when he resigned as chief engineer of the Bureau of Highways, Borough of Manhattan, New York City, which position he had held for about three years. Mr. Durham was graduated in 1895 with the degree of C. E. from the School of Mines of Columbia University. He has been prominently identified with engineering work in New York City, on the Nicaragua and Cape Cod Canals and in Panama City.

CLARENCE E. RAYNOR, for the last 9 years assistant engineer on the Ashokan reservoir, has resigned to enter the valuation department of the Seaboard Air Line Railway, with office at Norfolk, Va. Mr. Raynor's work for the New York Board of Water Supply is now finished, which is the reason for his change.

W. D. WILKINSON has been retained by the city engineer of Pasadena, Cal., to work on an experimental sewage-disposal plant using the activated-sludge method. He was recently employed by Arthur R. Kelley on the valuation of the Southern California Edison Company's properties and those of the Great Western Power Company in San Francisco.

GUY F. HOSMER has severed his connection with O. Perry Sarle of Providence, R. I., to become engineer for the Maine Coated Paper Company, with office in Rumford, Me. Mr. Hosmer has been associated with Mr. Sarle since 1895 on all kinds of engineering work in the East.

ALBERT W. NEWTON, formerly assistant to the president of the Chicago, Burlington & Quincy Railroad, has been appointed chief engineer, with headquarters at Chicago, to succeed T. E. Calvert, deceased. Mr. Newton was engaged in general engineering practice from 1892 to 1898, and the follow-

ing two years was engineer of the Sny Island levee and drainage district, with headquarters at Pittsfield, Ill. His first railroad experience was with the Chicago & Alton Railroad from 1900 to 1903, during its reconstruction period. Mr. Newton was employed as assistant engineer, with headquarters first at Kansas City, and later at Bloomington, Ill. On March 15, 1903, he first entered the service of the Burlington as construction engineer at St. Louis, in charge of the Old Monroe (Mo.) to Mexico extension. On Oct. 1, 1904, he was ap-

New Chief Engineer of Burlington
Railroad



ALBERT W. NEWTON

pointed assistant engineer, with office at Chicago, and on Dec. 1 of the same year returned to St. Louis as engineer of the Missouri district. He became general inspector of permanent way and structures in the office of the vice-president, with headquarters at Chicago, Jan. 1, 1907. With the exception of a short period between Nov. 1, 1908, and Feb. 5, 1909, when he was temporarily division superintendent at Creston, Iowa, Mr. Newton continued in that position until Jan. 1, 1915. Jan. 1, 1914, he was appointed chairman of the federal valuation committee of the Burlington, and in connection with these duties became chairman of the engineering committee on the Western Group, Presidents' Conference Committee on federal valuation, both of which positions he still retains. His appointment as assistant to the president, with headquarters at Chicago, became effective Jan. 1, 1915.

B. S. REMINGTON has been engaged as assistant engineer on the Chandler (Ariz.) irrigation project, for which Quinton, Code & Hill of Los Angeles are consulting engineers. The work, involving an expenditure of \$500,000, has been contracted for. Mr.

Remington was graduated at Ames, Iowa, in 1907. His first work was as rodman on construction for the Chicago, Milwaukee & St. Paul Railway in Montana. After working for various roads, he was made assistant engineer for the Canadian Northern Railway. For five years he had charge of the \$2,000,000 revision across Rainy Lakes, Ontario. For the last two years Mr. Remington has been employed on paving work in California.

HORACE DUNAWAY, formerly topographer with the U. S. Geological Survey, and later junior engineer in the U. S. Engineer's office at St. Paul, has again taken up engineering work after a two-year period of poor health. He has opened an office at Elbow Lake, Minn., as drainage engineer.

W. H. SCALES, secretary and chief engineer for the Blackhawk Construction Company, of Waterloo, Iowa, has been elected a vice-president of the firm. He is at present in Fort Worth, Tex., on a two-month leave of absence.

CLARENCE W. HUBBELL, consulting engineer, of Detroit, has been appointed city engineer to succeed R. H. McCormick.

H. B. SCHELLHUS, formerly chief engineer of the proposed Lafayette & Northwestern interurban railroad, has opened an office for general engineering in partnership with F. J. Herring at Forest City, Ark. Recently Mr. Schellhus was employed on valuation work with the People's Gas Light & Coke, Company, Chicago.

MOULTON ENGINEERING CORPORATION, of Portland, Me., has opened a New York office in the Woolworth Building, in charge of Horace W. Flashman, who has been associated with the Westinghouse Electric & Manufacturing Company for a number of years. The facilities of the home office are also being extended.

J. L. STEPHENS, for the last five years assistant city engineer of Mishawaka, Ind., has been appointed city engineer to succeed C. W. Cole.

C. W. COLE has resigned as city engineer of Mishawaka, Ind., to open consulting offices in the J. M. S. Building, South Bend.

R. C. WHITE, formerly engineer maintenance of way of the Southern district of the Missouri Pacific Railway, has been appointed superintendent of the Memphis division, with headquarters at Wynne, Ark. He succeeds D. O. Onellet, who has been transferred to the Valley division, with office at McGehee, Ark.

DEGNON CONTRACTING COMPANY has located its main offices in the Queens Subway Building, Hunterspoint and Van Alst Avenues, Queens Borough, New York City.

S. CAMDEN MILLER has resigned as operating engineer for the Canton (Ohio) Bridge Company, to take effect the last of February. He has announced no plans for the future.

HENRY JACKSON BURT, civil engineer for Holabird & Roche, architects, Chicago, was elected, Jan. 5, president of the Western Society of Engineers. After graduation from the University of Illinois in 1896, his first work was on estimates in connection with a proposed belt line in Chicago. For two years he was employed in drafting, designing and estimating structural steel in the New Orleans office of the Gillette-Herzog Manufacturing Company, of Minneapolis. For a few months in 1899 he was resident engineer on construction work for the Chicago & North Western Railway,

New President of Western Society of Engineers, Chicago



HENRY JACKSON BURT

which was followed by employment on a track-elevation survey for the Chicago & Western Indiana Railroad in 1900. Then followed his incumbency of an assistant professorship in civil engineering at Iowa State College for a year. For ten years he was with the American Bridge Company, three years in charge of contracting, designing and estimating at the Salt Lake office and six years in charge of the Denver office. In 1911 he accepted the position he now holds. Mr. Burt is the author of a book on steel construction covering the design of steel framework for buildings. He has been active in all engineering societies in the cities where he was located. In Denver he, with H. S. Crocker, was largely instrumental in making a success of the Colorado Association of Members of the American Society of Civil Engineers. Mr. Burt was its first secretary and later its president. His services for the Western society as chairman of the committee on the structural engineers' license law accounts in a large measure for the popularity which has resulted in his election as president.

A. PEARSON HOOVER, formerly contracting engineer for the John W. Ferguson Company, of Paterson, N. J., is now associated with E. P. Goodrich, consulting engineer, of New York City. Mr. Hoover received his education at Roanoke College and Rensselaer Polytechnic Institute. During the two years that elapsed between his terms at these two institutions, he was employed by the engineering department of the Baltimore & Ohio Railroad. After leaving Rensselaer in 1905 he was appointed engineer for the Shaw Engineering & Manufacturing Company, New York City. Then followed work on various buildings, among which are the 11-story concrete structure built for the McGraw Publishing Company Inc., the American Woolen Building and the Pocono Building, in New York City. Since 1913 he has been associated with John W. Ferguson.

SHIRLEY BAKER, formerly construction engineer, E. E. Carpenter, formerly chief civil engineer, and William Waters, formerly superintendent of building construction for the Panama-Pacific International Exposition, have opened offices for the practice of general engineering under the firm name of Baker, Carpenter & Waters, in the Holbrook Building, San Francisco.

W. O. McCLUSKEY, JR., has been appointed county road engineer of Ohio County, West Virginia, to succeed George W. Steenrod. Mr. Steenrod will not retire from office until February.

Obituary Notes

HENRY K. COOPER, civil engineer, of Springwater, N. Y., died recently at the age of 86 years. He was born in New Bedford, Mass., in 1830. In 1851 and 1852, when the Rochester-Corning branch of the Erie Railroad was built, Mr. Cooper directed much of the surveying and construction.

Civil Service Examinations

United States—Examinations will be held Feb. 6 for mechanical draftsman, salary \$3.52 to \$6 per day. Ask for form 1312. Examinations will be held Feb. 7 for sanitary engineer, salary \$1,600. Applicants should fill in form B. I. A. 2. Other examinations on Feb. 7 are for electrical assistant, salary \$1,200, and for junior physicist, salary \$1,500. On Feb. 7 and 8 applicants will be examined for positions as mechanical laboratorian, salary \$4.24 per day. Form 1312 should be filed by applicants for these positions.

Chicago—Examinations will be held Jan. 19 for rodman, salary \$70 to \$90 per month, for the West Chicago Park Commission. Applicants will be assembled in the Union Park Office.

Engineering Record

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Number 3

Helping the Bidders

AN UNUSUAL and extremely commendable plan for helping contractors bid intelligently on a \$1,000,000 road job has been worked out by the officials of Cook County, Illinois. To supplement the customary information, two maps of the county have been prepared—one to show the location of suitable sources of sand, gravel and stone; the other to indicate the location and capacity of railroad sidetracks. The railroad map also shows the highways under construction and therefore not usable, while the material chart gives, in tabular form, the names and addresses of the supply companies in the respective neighborhoods. By studying the maps, contractors can also determine those roads over which they will have to drive heavy motor trucks and can learn in advance the length of haul and in which towns they must obtain permits for their trucks to travel. The Cook County Department of Highways should be commended for making it easy for contractors to bid on this work. Moreover, the county will undoubtedly get returns, through lower prices, far exceeding the cost of preparing this helpful information. Elimination of uncertainties is a sure way of reducing costs.

Fakers

HERE is an opportunity for constructive work by every engineer and contractor. A number of anti-freezing compounds are on the market this winter, and their advocates are offering 10 per cent commission to architects who specify the use of the mixtures in concrete. Of two of the compounds analyzed, one contained 85 per cent of common salt, 5 per cent caustic soda and 10 per cent of powdered lime. Two pounds of the mixture were to be used to the bag of cement. The other compound analyzed 80 per cent common salt, 10 per cent soda ash and 10 per cent powdered lime; the instructions call for 3 lb. of the mixture to the bag of cement. Not only is the use of these compounds contrary to good practice—in that they employ salt—but the promoters are trying to undermine the educational work which has been done in the effort to make winter concreting safe. The agents and their literature are preaching against the use of heated water, contending that their compounds furnish the safeguard needed. Those who have given the matter consideration know that if the materials are heated, the structure properly protected and kept at the proper temperature, no other precautions need to be taken. If some architects and constructors do insist upon putting something in the mix, they should not, through a false sense of security, neglect the

ordinary heating precautions, and above all should not play the part of an ordinary "sucker" and pay fancy prices for common salt. Here is an opportunity for everyone to wield his hammer in a good cause.

Commissioner Daniels

RAILROAD managers find considerable encouragement in the confirmation by the U. S. Senate of the reappointment of W. M. Daniels as member of the Interstate Commerce Commission. There was strong opposition to him, in which Senator Cummins of Iowa is understood to have taken a prominent part. It was held that his advocacy of rate advances in the summer of 1914—shown by the railroad earnings of the last year, his opponents said, to have been unnecessary—disqualified him for further usefulness on the commission. The Senate was not fooled, however. It saw that the present wave of prosperity could not have been predicted in 1914. It probably saw further that even the large railroad profits during the past year have not been excessive, considering the preceding lean years, the doubtful durability of the present prosperity and the danger of further inroads on the railroad income by the brotherhoods. It must have seen, too, that members of the Interstate Commerce Commission must feel free to exercise their best judgment on the problems they investigate, without fear of a Senate that has not gone so deeply into the problems. Commissioner Daniels will therefore continue to exercise that judgment, and will probably continue to feel that a square deal for the railroads is not incompatible with service to the nation.

Official Status for Research

IT WILL BE of intense interest to all who have followed the discussions in this country of the relation of scientific research to industrial efficiency and to military and industrial preparedness to learn that the British government has set up an "Imperial Trust for the Encouragement of Scientific and Industrial Research," and has given it a status equal to that of the Board of Trade, the Board of Agriculture, and the other executive organizations comparable, in the English system, to our executive departments. In other words, industrial research has been given a national and official standing in England. Differing somewhat from the practice here, however, it is the expectation that the trust will be supported not only by Parliamentary grants but by gifts from individuals. In fact, two members of the Institution of Mechanical Engineers have already

made substantial contributions. It is further announced that the English Government expects to appropriate about \$5,000,000 for research work during the next five years. This action follows naturally the investigations which have been made since the beginning of the war—investigations which have been followed here by the organization of the National Research Council and its efforts to co-ordinate the investigational resources and abilities of the entire country. The English action, however, differs from our own in that our own efforts are purely private and that the government, without contributing funds, is participating only as would any private organization. If we eliminated the “pork” from our system we would have ample funds for aiding research work.

Has the Highway Engineer's Work Just Begun?

TO highway engineers there is a deep significance in the comparative figures for passenger service rendered by automobiles and steam railroads, given on page 112 by H. W. Perry, of the National Automobile Chamber of Commerce. His calculations show that for automobiles the total passenger-miles per year have reached the remarkable figure of 45,000,000,000 as against slightly more than 35,000,000,000 passenger-miles for the railroads. The latter figure, however, is based on statistics for 1914. Reduced to dollars and cents, the statistics indicate that automobile service, at 2 cents a mile per passenger, is worth \$900,000,000 yearly, or \$200,000,000 more than that rendered by all of the steam railroad systems of the country. It should be noted that these figures apply to pleasure automobiles.

As regards the motor truck, the story is different. While commercial vehicles are making rapid strides, they are still far behind the steam roads in ton-mileage of freight carried, the figures being less than 4,000,000,000 ton-miles yearly for motor trucks and 288,000,000,000 ton-miles for the railroads. Again the railroad figures are for the year 1914. Due to the immense increase in freight delivered for export, it is safe to assume that a comparison, based on the records of 1916, would show a still larger difference in favor of the railroads.

To the man who looks ahead a few years, these statistics furnish grounds for believing that, in spite of the millions of dollars that have been spent upon roads and pavements, the real work of the highway engineer has scarcely begun. To what proportions will motor traffic increase, say, in the next ten years? How will present standards of highway construction be affected? Will road widths and grades, sanctioned to-day, be adequate to-morrow? What influence will legislation have upon the conservation of our highways and the development of motor-propelled traffic?

These are some of the questions which occur to the highway engineer who digests Mr. Perry's figures. Upon them all sorts of speculation may be based. Cer-

tain it is, however, that the road-builder is destined to assume a position of far greater importance than he occupies to-day.

Flat-Slab Design

THE long-awaited final report of the joint committee on concrete of the American Society of Civil Engineers contains a most important contribution on the subject of flat-slab design—a moot question for the past few years. The committee, especially the subcommittee on design, consisting of Professors A. N. Talbot, W. K. Hatt, and F. E. Turneure, is to be congratulated on the clearness and definiteness of this new section. The subject was entirely omitted in the progress report of 1912, which has been so generally adopted by the engineering profession.

In the abstract, which appeared on page 55 of last week's issue, the important respects in which the methods recommended differ from present general practice were pointed out. Especially fortunate are the suggestions for the division of total bending moment between the positive and negative sections in the proportion of three-eighths and five-eighths, and the requirements for the distribution of steel across the sections, based upon new assumptions regarding the distribution of stress in these sections.

Knowing the personnel of the subcommittee on design, it was to be expected that conservative practice would be recommended—in fact, it will be noted that some of the provisions closely accord with the present Chicago building-code requirements. The treatment is both empirical and rational and, in the opinion of this journal, deserves general approval.

As a whole, the report is excellent. Especially to be commended are the increases in required time of mixing and the emphasis on the importance of the quantity of water. The former has been advocated by this journal for years. The latter it has repeatedly emphasized, particularly since the new knowledge has pointed out the grave necessity of reducing the customary volume of mixing water.

A Move for Better Contracts

THE first definite step has been taken toward securing equitable construction contracts under which the cost of carrying out engineering work can be reduced by laying all the cards on the table and eliminating needless uncertainties.

The General Contractors' Association, an organization numbering among its membership a large percentage of the important contracting firms of the country, many of whose officers, by the way, are prominent in the American Society of Civil Engineers, has appointed a committee to bring the whole matter to a head. It is expected that the work of this committee, the appointment of which has just been announced, will include, first, the determination of what general standards and principles should govern engineering contracts. Next,

it is believed, the committee and the association will bend every effort to secure the adoption of such standards by engineers.

Will the American Society of Civil Engineers wait until the second stage of these proceedings has been reached, and until contractors have forced its members to institute reforms that, after all, will be of most benefit to clients of the engineering profession? Such reforms should come from within. When they are forced from without, there is a serious reflection on the body reformed.

As this journal has said time and again, with all the emphasis at its command, a reform in contract practice among engineers is overdue, and is coming just as surely as it came in architectural work some years ago. The architects had the perception and the energy to join in and help work out their own salvation. Will the engineers do less? Can they afford to do less? Will they dare do less?

Immediate and definite action by the American Society of Civil Engineers, looking toward co-operation with the contractors who have initiated this movement, is required. Otherwise its members will be in the awkward position of being forced into a reform of which the society should have been the instigator.

New Tests of Steel Columns

WHILE the number of new tests reported this year by the special committee of the American Society of Civil Engineers is not large, the results confirm the tendencies previously announced for the extensive series of tests conducted by the U. S. Bureau of Standards under the co-operative auspices of the civil engineers' society and the American Railway Engineering Association. The latest progress report, abstracted on page 66 of last week's issue, gives the results of the three lines of investigation proposed in the previous report and lays down the plans for the future.

In the first place, the results for new short columns (slenderness ratio 20) duplicating the tests on sections from previously tested long columns show close agreement with the older results, both for ultimate strength and yield point, and confirm the suggestion made last year that lower yield points in compression for the heavier column material explain the lower strengths of columns made of heavier material. In the second place, results for extra-heavy sections of two types, tested for the purpose of finding whether the decrease in strength with thick material was progressive, indicate that for rolled H-columns this falling off in ultimate strength is extremely large for all three slenderness ratios tested, while on the other hand the thicker material in built-up I-sections caused but slight decreases in strength. In the third place, the results for long columns (slenderness ratio 155) appear to indicate much less reduction of strength due to length than would be expected.

The investigation of the metal in the columns by tensile tests of specimens cut from parts of the main

sections or by compressive tests of angles, as reported, is not extensive nor are the results convincing, except qualitatively, as indicating the fact that low yield points for thicker metal predict lower ultimate strength for columns of that material. The report reveals the uncertainty of the committee as to exact methods for determining the yield point of columns, and it is to be regretted that the tests were not conducted as suggested editorially in the Engineering Record of May 8, 1915, page 574, that is, by repeating the application of stress, without increase, as often as there are resultant increments of permanent set. It is believed that such a method of test would at once settle the question raised by the committee as to how the yield point of columns should be found. When the permanent sets are found to increase progressively without increased loading and possibly even under decreased loading, this point, similar to Bauschinger's "stretch-limit" in tension tests, will be known. The important influence of the time element, so far as the report indicates, has been given no further attention by the committee. The close relation between yield point of the metal, yield point of column and ultimate strength of column is recognized in this connection. The results of tests on large columns reported in the Engineering Record of July 1, 1916, page 19, should be mentioned as showing this same relation for various alloy steels.

As advocated editorially on page 68 of the Engineering Record for Jan. 15, 1916, it is peculiarly incumbent upon the society to see that these test results are exhaustively analyzed. It is hoped that the question raised as to the relation between yield points of the component metal in tension and in compression will be more definitely investigated. The few tests just reported show the yield point in compression to be about 2000 lb. per square inch lower than in tension for the material in the angles of the built-up I-sections. Thorough study of the completed test results now available to find an arbitrary deformation point which can be used as a criterion of the strength of the column and to fix the safe working values is proposed.

This journal repeats the suggestion made in the editorial previously mentioned that some of the columns already tested should be duplicated under the A. R. E. A. specifications in order to obtain a reasonable basis for estimating the strength of columns fabricated as in ordinary commercial practice. This can well be made part of the proposed investigation for determining the effect upon column strength of minor details such as lacing, tie plates, etc. While recognizing the claim of the committee that its duty does not require it to continue the investigations until the subject is exhausted, it is a fact that the original appointment of the committee "to consider and report upon the design, ultimate strength and safe working values of steel columns and struts" clearly requires a consideration of all the factors which affect the allowable working strength of columns—and this surely means an investigation to find the crippling loads on commercial columns, and their relation to the "gilt-edged" columns of these tests.

Form Travelers Hoist Canal-Wall Concrete

Excavation for Chicago's Calumet-Sag Channel, Made by 328-Ton Shovel, Flanked by Concrete Walls Built with Special Plant Developing New Economies

By E. P. ABBOTT

Engineer, A. Guthrie & Company, Blue Island, Ill.

TRAVELERS in use on sections 13 and 14 of the Calumet-Sag Channel at Blue Island, near Chicago, not only carry the steel forms for 50-ft. wall monoliths, but also hoist the concrete skips from trains on the lock floor and discharge their contents mechanically to any part of the form. A large central concrete plant is in use. The cement is unsacked in the cement shed and supplied to the mixers by long chutes through the aggregate bus. The main canal section is being excavated by a 328-ton revolving steam shovel able to make the full cut and load disposal trains on the bank.

WORK INVOLVES LARGE QUANTITIES

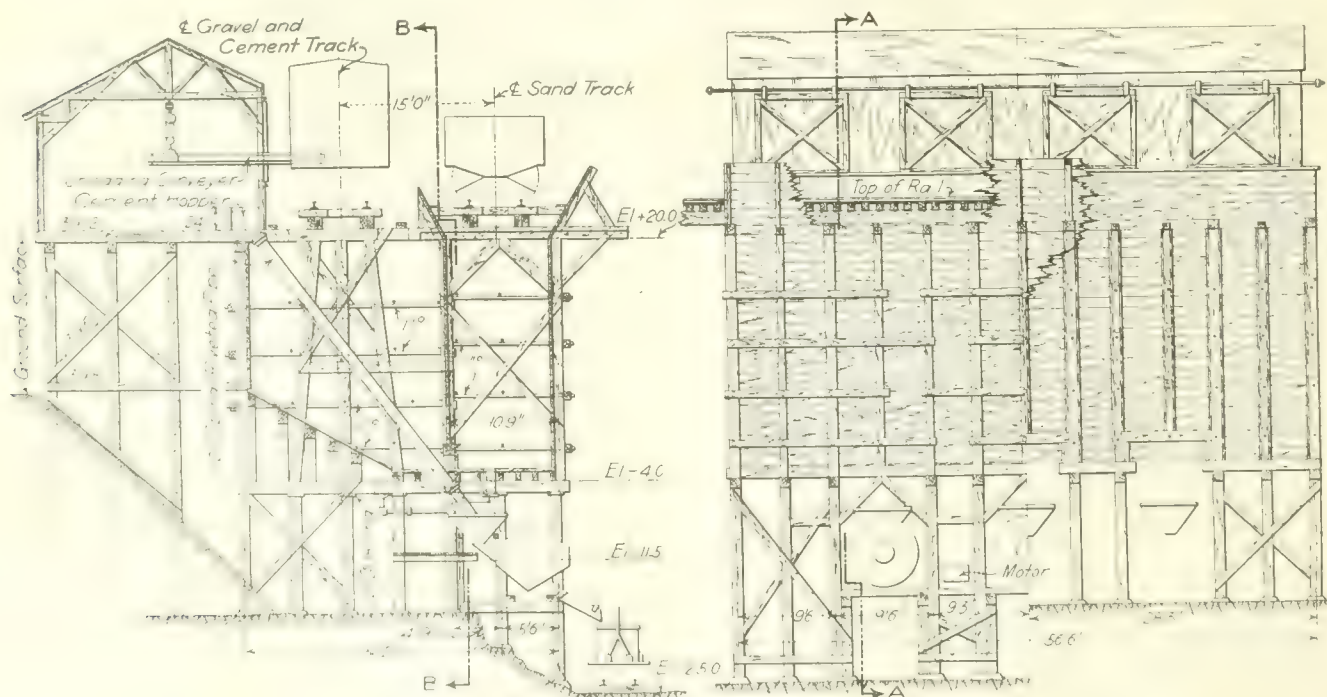
The Calumet-Sag Channel is a 16-mile drainage and ship canal that is being built by the Sanitary District of Chicago to carry the sewage from the Calumet district into the drainage canal. The channel extends from the Little Calumet River, near Blue Island, Ill., to a junction with the Sanitary and Ship Canal of Chicago near Sag.

Sections 13 and 14, which are the two sections at the east end, are now well under way and involve heavy, difficult construction work. Section 13 is within the corporate limits of the city of Blue Island and includes two main-line railway crossings. Section 14 adjoins the river and contains the controlling works and sewage-discharge chamber. The two sections together are $2\frac{1}{4}$ miles long, require the excavation of approximately 1,500,000 cu. yd. of glacial drift and rock and the placing of 190,000 yd. of concrete, 500 tons of structural

steel and 4000 tons of reinforcing metal. This portion of the channel is to be lined on both sides with gravity concrete retaining walls, which are 50 ft. face to face in the controlling-works section, 100 ft. in the 1000-ft. lie-by and 63 ft. in the standard section. The walls vary in height from 26 ft. in the standard section to 40 ft. at the controlling works.

REVOLVING SHOVEL SELECTED FOR EXCAVATION

Because of the irregular and restricted spoil areas and the fact that the top of spoil is limited to a fixed elevation, which makes the maximum fill 20 ft. with the average about 10 ft., it was not economical to do the work of excavating with dragline machines. The main channel excavation is being made with a Model 300 Marion steam shovel, which is the largest type of shovel yet built. The shovel is of the revolving type, weighs 328 tons and is equipped with an 80-ft. boom, 52-ft. dipper stick and an 8-yd. bucket. It operates on two tracks 26 ft. center to center and is mounted on four swiveling trucks, each having four 30-in. double-flanged wheels, all of which are geared direct to the propelling engine. An equalizing device, which gives all the flexibility of a three-point suspension, consists of four hydraulic cylinders with pistons connected to the trucks. Hand circulating pumps operate the pistons and permit the machine to be moved over uneven track without torsional strains in the lower frame resulting from unequal distribution of the weight. The shovel will excavate a cut 116 ft. wide at grade and will load



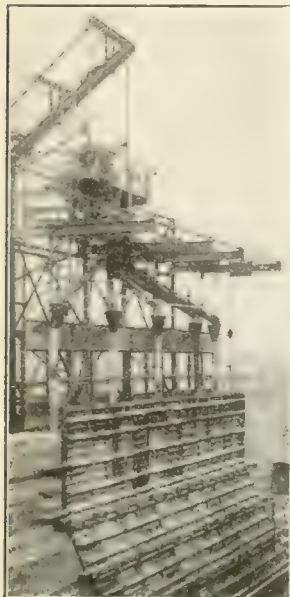
CEMENT SACKS NEVER LEAVE THE HOUSE IN GRAVITY CONCRETE PLANT, WHICH LOADS 6 BUCKETS IN 2 MINUTES

carts 58 ft. above and 95 ft. from its pivotal center. It has been possible in all but the lie-by section to make the cut the required width from one position in the center of the channel.

The excavated material is loaded into standard-gage 20-yd. Kilbourne & Jacobs air dump cars, which are hauled by 67-ton Baldwin locomotives to the nearest spoil area. These areas are located along both sides of the channel. The fills are started by dumping from trestles, the cars being pushed out ahead of the locomotive and dumped. When a trestle is filled it is dozed

ing is being done with Ingersoll-Rand Jackhammer drills, with air furnished by two Chicago Pneumatic Tool Company's fuel-oil, direct-connected compressors, each with a capacity of 325 cu. ft. of free air per minute.

The Jackhammer drills were selected after test runs were made by the different companies furnishing air-operated hand drills. The requirement was that 13-ft. holes should be bottomed to $1\frac{1}{2}$ in. with seven changes of steel. The best results obtained by these tests for 84 lin. ft. of holes drilled were: Total drilling time,



FORMS HUNG ON STEAMBOAT RATCHETS—DISTRIBUTING SPOUTS SAVE SHOVELING—FORM TRAVELER OPPOSITE CONCRETE PLANT

out 16 ft. on each side with a Jordan spreader propelled by locomotive, and the track is then thrown out to a new position on the shoulder by the dump.

TRACK-THROWING DERRICK CAR USEFUL

The track is handled by a track-throwing derrick car, which is a 10-ton derrick with a 40-ft. boom mounted on a standard flat car. The car is equipped with a removable auxiliary horizontal boom 35 ft. long that fits into either of the two foot castings mounted on the forward corners of the car and is held in a fixed position by a strut and cables. By means of a chain bridle the track, ties and all, is picked up vertically by the load line and is then pulled to the side by a line attached to the bridle, which passes over a sheave at the point of the auxiliary boom and back to a nigger head on the engine. The car, which is self-propelled, starts at the end of the track to be moved and backs away from the thrown track. The track is thrown from 4 to 6 ft. at a time, which is as much as it will stand without bending the rails and breaking the angle bars. The derrick is equipped with a three-drum hoisting engine and four nigger heads independently operated by clutches. Besides throwing track, the car unloads heavy material, carries material from one part of the job to another, and does a great many other things that can be accomplished by it more easily and cheaply than by any other means.

The rock encountered is Niagara limestone in nearly horizontal strata overlaid with glacial drift. All drill-

ing includes delays incident to the changing of steel, blowing out of holes, etc., 1.78 minutes per linear foot of hole; and actual cutting time, 0.94 minute per linear foot. A record is kept of the linear feet drilled each day, which has averaged 139 ft. per man per ten hours, with the best day's average 234 ft. The holes vary in depth from 3 to $10\frac{1}{2}$ ft. and average between 6 and 7 ft. The steel used is $\frac{7}{8}$ -in. hollow hexagonal, and the best results have been obtained with cross bits.

DRILLED HOLES CARRIED BELOW GRADE

The drilled holes are carried 18 in. below grade to insure the rock being broken sufficiently low, and are spaced a distance apart equal to two-thirds the depth of the holes. The top two to three layers of rock are separated by clay seams, which have made drilling difficult because the drills often wedge and stick between the layers. These clay seams have also interfered with the blasting, the strength of the blast being dissipated through the seams. In some places it is necessary to reload and shoot the bottom 2 to 3 ft. of the holes after the top rock, broken by the first blast, has been cleared away.

The blasting is all done with electric current, and from 250 to 500 holes are shot at once. At first the dynamo that furnishes current to light the shovel was used. However, it did not have sufficient capacity, and now 220-volt alternating current, obtained from the local electric company, is employed.

The concrete-mixing plant, as shown in the drawing,

is a gravity plant even to the method of getting the cement to the mixers. Washed sand and gravel are received in hopper bottom cars. The cars are set on the contractors' storage tracks by the railroad company and the contractors' forces do all the necessary switching. A trestle with a maximum height of 48 ft. connects the top of the spoil bank with the bunker plant, which is built flush with the north face of the finished channel wall. The sand track is laid out in a 12-deg. reverse curve from the spoil bank and the gravel and cement track switches off from it. The two tracks become tangent at the bins on 15-ft. centers, which is the correct spacing for storing the proportionate amounts of aggregate. The storage bins hold sufficient material for 1000 yd. of concrete.

The cement shed, which is supported on piles at the side of the gravel bins, has a capacity of 2000 bbl. of cement. The floor of the shed is 6½ ft. below the floor of the cars, so that practically none of the cement has to be trucked up grade. The plan is to install an 18-ft. portable electrically driven belt conveyor which will hang from an I-beam track running the length of the building. The conveyor will be carried on rollers in a sling, which will be hung by a chain block from a carriage on the I-beam. This will allow the conveyor to be pulled out to a bearing on the car floor, while with the chain block the unloading end can be elevated and lowered as desired. With this arrangement the conveyor may be used at any one of the four doors of the cement shed.

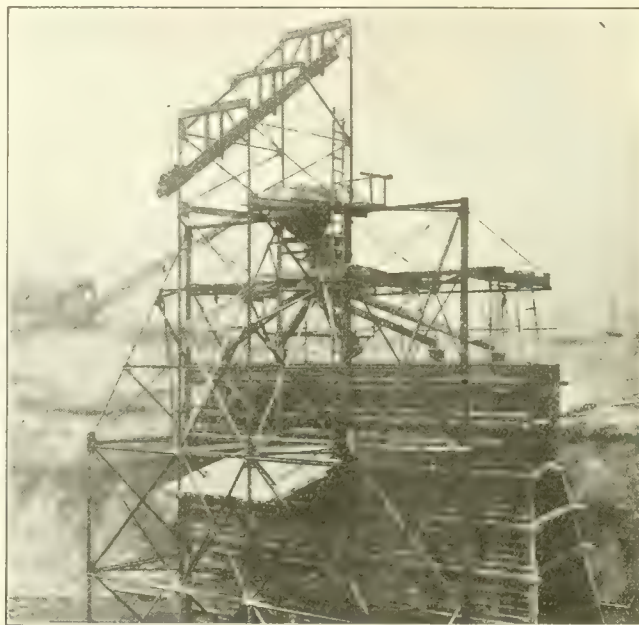
CEMENT FED THROUGH PIPES

Cement is fed to the mixers through 12-in. spiral-riveted pipes, which extend from the cement shed to the charging hoppers at the mixers through the gravel bin. The correct amount of cement for one batch is measured into one of the cement charging hoppers and is held until a gong signal is received from the mixer operator to release it by opening the sliding gate at the floor level. The original plan was to have an airtight valve at the lower end of each cement pipe, which would be opened by the mixer operator as he discharged the batch into the mixer. It was found, however, that the cement acted like water under pressure, and as soon as the flap gate was unlocked and raised the least amount from its gasket seat the cement poured out all around the opening to such an extent that considerable cement was lost. The great amount of dust made this method impracticable. To overcome this difficulty 6-ft. extensions, which taper from 12 to 5 in., were placed on the ends of the pipes in place of the valves. This brings the discharge well down into the charging hopper and under the sand and gravel, which act as a seal against the force of the cement as it comes down the pipe. A small hole drilled in each extension acts as an indicator, so that the operator will know that the cement signaled for has been received. The scheme has proved entirely successful and very economical. It will be noted that the cement sacks never leave the cement house. In this way all loss of sacks is eliminated.

The mixing is done in three 30-ft. Smith mixers, each direct-connected to a 25-hp. motor. All the levers are so placed that only one man is required to charge and dump each mixer. The concrete is discharged into 36-ft. capacity bottom-dump buckets on cars and is hauled

on the bottom of the channel to the forms. The cars are so spaced that they are a distance apart equal to the distance center to center of the mixers. Three cars per train, with two buckets to a car, are used, making 6 yd. per train. As soon as the train is spotted in front of the mixers each machine discharges the batch it is mixing. A second batch, which is held in the charging hopper, is emptied into each mixer as soon as it is righted, and by the time the train is again spotted the second batch from the mixers is ready to be discharged. By this arrangement the time of loading is less than 2 minutes for six batches of concrete.

Six sets of steel forms, each 50 ft. in length, and hung from cantilever steel travelers, are used for the canal walls. The travelers are placed in the bottom of



TRAVELER HOISTS AND DUMPS OWN CONCRETE BUCKETS

the excavated channel and are carried on eight two-wheel trucks on rails 15 ft. apart. The central portion of each traveler extends up beyond the forms and carries an inclined track made of two 12-in. channels back to back, on which is mounted a four-wheel trolley. By means of a 7 x 10 hoisting engine placed within the traveler the concrete buckets are hoisted from the cars in the bight of a line to the trolley, and then driven up the inclined track to a latch, so placed that the buckets are centered over a receiving hopper of 3 yd. capacity, placed just inside the front columns of the traveler. As the hoisting engine slacks away, the bucket is lowered to a bearing on projecting angles bolted to its sides, and as the lowering continues the bottom of the bucket, which is held shut by the bail, opens and the concrete is discharged. Upon a signal the engineer picks up the bucket, which closes the bottom, and hoists it to the trolley. The latch is then disengaged by one of the men on top and the bucket is returned to the car. The buckets, engines and hoisting apparatus were furnished by the Mead-Morrison Manufacturing Company.

At the bottom of the receiving hopper is a gate which regulates the flow of concrete into a small bottomless hopper, which is pivoted in the center. By means of a long handle that travels along a curved beam it can be moved so that the concrete will be dis-

charged into any one of five chutes. These chutes terminate in line hoppers that center over the top of the forms 10 ft. apart. From these line hoppers, down spouts in 2-ft. lengths are hung down into the forms. With this arrangement of chutes all shoveling of concrete is eliminated and the concrete is easily brought up in horizontal layers.

FLEXIBLE DESIGN REDUCES NUMBER OF FORM PLATES

Steel forms are used with all the travelers. On the four travelers for the 26-ft. walls Blaw standard lagging plates are used. For the 40-ft. walls a new steel, hand-handled form is made use of, built up of 30-in. square plates, which fit between uprights 7 in. wide, which form part of the face of the form. Walers and lock bars fastened to the uprights by special hook bolts, which are made tight by wedges through slots in their ends, hold the plates in position. The walers are long enough to fasten on three uprights, while the lock bars break on each upright. The walers and lock bars alternate vertically, so that by removing the lock bars the plates may be removed without disturbing the uprights, which are held in position by the walers. As the tie rods pass through the uprights it is possible to erect, line and place the uprights to the full height of the form, while the plates need only be erected for the lower part. After the lower concrete has set, the plates can be taken down and fitted in above between the uprights that are already in position. This makes a light, flexible form that is easily handled by hand. After the standard walls have been poured with these forms, hung from the travelers, they will be removed and used for the special work at the gate recesses and curved walls as hand-handled forms.

RATCHETS ATTACH FORMS TO TRAVELERS

The forms are attached to the travelers with steamboat ratchets, by means of which they are raised, lowered and collapsed, as desired. When a form is ready to be moved, the traveler is pulled forward by an 18-ton dinkey locomotive with the aid of double blocks. The travelers, with the forms and counterweight for the larger walls, weigh 100 tons, but are easily pulled by the dinkey after they are once started with the aid of pinch bars. The actual moving time after everything is made ready is only a few minutes. The travelers were designed in conjunction with the Blaw Steel Construction Company, which furnished the steel forms.

The work on sections 13 and 14 is being done by A. Guthrie & Company, Inc., contractors and engineers, of St. Paul, Minn., and Portland, Ore. William H. Trinka is resident engineer for the Sanitary District of Chicago. Robert M. Knox is general superintendent, Dan T. Chamberlain superintendent on section 13, and Walter A. Byers superintendent on section 14, and the writer is engineer for the contractors.

Queer Accident Burns Up Road

An unusual accident which destroyed an oil distributor, tank and 100 ft. of road surface is recounted in the latest annual report of the Arizona State Highway Department. A live coal, dropped on the road by the steam roller pulling the oiling equipment, ignited the hot-oil spray and set fire to the oiling equipment.

Concrete Adapted to Storage and Industrial Uses

Examples of Successful Application of Concrete in New Fields Cited by J. E. Freeman—Oil and Gasoline Do Not Affect Good Concrete

SUPPLEMENTING the article in the Engineering Record of Oct. 14, 1916, page 470, which gives results of tests made for the Portland Cement Association to determine the effects of commercial liquids on concrete, there is here presented an abstract of the paper by J. E. Freeman, engineer of the technical division of the association, read at its December meeting. The adaptability of concrete in the form of storage tanks for such materials as mineral oils, gasoline and kerosene, creosote oil, molasses, pickling brine, and digester liquids has been investigated and the returns as given by Mr. Freeman are seen to be favorable to concrete. Especially under the conditions prevailing in the steel field during the last year, concrete is thus shown to be an economical material for such tanks.

ADVANTAGES OF UNDERGROUND TANKS

In considering the subject of storage of mineral oils, it is stated that the best type of construction for concrete oil tanks of moderate capacity (500 to 30,000 bbl.) seems to be the underground tank, which keeps the oil at fairly even temperature and reduces the risk of fire from lightning or other causes. There is also a saving in the gasoline value of crude oil by the checking of evaporation, which one company estimates at 15 to 20 per cent as compared to steel tanks above ground. Insurance on oil storage is reduced 50 per cent for such an underground tank, in addition to the saving in the reduction of maintenance and repair costs.

Two tanks for storage of lubricating oil have been reported in service for 6 and 9 years respectively without effect upon the strength of the concrete. A small demonstration tank of 250 bbl. capacity at Sapulpa, Okla., has held gasoline for more than a year, and has resulted in the construction of a 2500-bbl. tank, which has recently been placed in service. The inside of this tank was given a special coating, but in view of the reported success of underground storage tanks for gasoline in Canada with only a rich mortar finish, this matter is worthy of further investigation. Several firms plan to build creosote-oil tanks this coming year, and as the specific gravity is close to that of fuel oil it is believed that the construction will prove satisfactory.

CONCRETE TANKS FOR MOLASSES

Reports from Missouri describe two concrete tanks, each for 7500 bbl., which cost 20 per cent less than similar steel tanks for the storage of molasses. Underground tanks for the same purpose have been reported in use for from 6 to 14 years and have proved very successful. In many cases, beyond plastering with mortar, no special coating was attempted, and no effects have been observed either upon the strength of the concrete or the quality of the molasses.

A pickle and preserve company in Utah had twenty 5000-gal. tanks built four years ago. They are filled with brine and vegetables, such as cucumbers, onions, cauliflower and sauerkraut. After one year's service

the tanks containing cauliflower showed evidence of slight action, and were coated with well-drying oil paint. In all cases the other tanks have been operating with complete success. At an olive growers' association plant in California 600 concrete vats built in pairs some 10 years ago are used for olive pickling, involving lye solution and brine, and they show no effects from action of any kind.

Finally, reference is made to the use of concrete for digester tanks in the paper-manufacturing business. Such a tank, 15 ft. in diameter and 42 ft. high, provided with special acid-proof lining, was constructed about four years ago at Austin, Pa. It operates under 100 to 150 lb. steam pressure, and the company considers it superior to other types. No trouble has been experienced, and a recent test showed no leaks. The advantages claimed are low initial cost, small loss in radiation and long life of linings.

Three Washed-Out Steel Spans Replaced in Ten Days

Rapid and Difficult Salvage Work Follows July
Flood Damage to Southern Railway
Bridge Near Fort Mill, S. C.

UNUSUAL reclamation work marked the strenuous efforts of the Southern Railway to put its lines in North Carolina and South Carolina into operation again after the complete tieup following the washout of bridges over the Catawba River in the disastrous flood which reached its highest stage on July 16. The bridge near Fort Mill, S. C., where eight deck truss spans were carried several hundred feet down the river and the masonry piers badly wrecked, was rebuilt by timber trestle and the replacement of three of the 100-ton steel spans, and service was resumed Aug. 7 on the Charlotte-Columbus line.

The replacement of these spans, which had been turned over and floated away practically without damage, was accomplished in about ten working days in spite of high water difficulties, while the trestle work was being pushed from the opposite end. Timber cribs and blocking, high-speed jacks, cables, a derrick car and a wrecking crane were utilized in righting the spans and shifting them, in some cases as much as 500 ft., to restore them to their original position.

The Southern Railway lines were cut completely by the July flood at four points on the Catawba River.



END SPAN PLACED—SECOND SPAN RIGHTED

The bridge at Belmont, N. C., on the main artery of travel between the North and the South, was restored thirteen days after it went down, five days being required to replace 600 ft. of embankment on the approaches. Piling from 75 to 90 ft. long had to be driven to support the trestles and temporary spans. When this bridge suddenly gave way on July 16, seventeen employees of the railroad, who were attempting to save the structure by freeing the drift under it, were swept into the river, and ten lost their lives.

EIGHT SPANS OVER CATAWBA CARRIED OUT

Eight 125-ft. spans over the Catawba River near Fort Mill, S. C., also were carried out, but with practically no damage to the steelwork. In addition to the work of placing timber trestles on piles, which was carried forward continuously night and day, it was possible to replace three of the 100-ton steel spans on the north end in the same time, and traffic was restored on Aug. 7. The methods used are indicated by the photographs.

These three 100-ton steel deck spans, 125 ft. long, 16 ft. wide and 22 ft. deep, which lay on the river bed



TEMPORARY TRACK FOR DERRICK CAR

either on their sides or upside down, were righted by high-speed jacks and timber frames (see photographs), aided by steel cables and a derrick car. After righting, they were shifted laterally back to the piers by the usual methods, using steel rollers on steel rails. These were laid upon 8 x 16 in. timber stringers spanning between 10 x 10-ft. timber cribs sunk in from 6 to 8 ft. of water. These cribs were made of 8 x 10 and 7 x 16-in. timbers drift-bolted together, and were difficult to place because of the interference of rubbish and large stones washed out of the piers. They were anchored to the piers or shore by cables to prevent the swift current from carrying them away.

When the end span had been moved back to the site, its shore end was lifted by a wrecking crane, as indicated in one of the photographs, and the other end was jacked up on temporary timber blocking on and around the damaged masonry pier. This span was thus raised and adjusted into its proper position and the wrecking crane run out upon it to aid in lifting the adjacent span.

Meanwhile the next two spans had been shifted back to the piers, lashed together and all preparations made to jack and hoist them into place as one unit up to the



TIMBER CRIBBING SUPPORTS RUNWAY RAILS FOR SHIFTING END SPANS BACK TO PLACE

top of the piers. The platform for jacking them up 12 ft. higher to their final position was made by 12 x 12-in. timbers laid crosswise on the piers and extending as cantilevers on each side about 6 ft., for working platforms. As the jacking proceeded 12 x 12-in. timbers were placed under them alternately crosswise and lengthwise.

Three spans were thus replaced by the time the other five openings had been closed by the trestle work which can be seen in the photographs. It required about ten working days with a force of 100 men, about 90 of whom were common colored laborers available in the vicinity and were used for excavating and clearing out the great masses of rubbish and handling the large amount of timber which was necessary to perform the work.

EMERGENCY TRANSFER OF CONTRACTOR

The replacement of the steel spans was done by the Southern Railway Company's forces, assisted by the John Eichleay, Jr., Company, of Pittsburgh, at that time employed by the company to move its passenger station at Danville, Va., the forces being transferred to Fort Mill to assist in the emergency. Forces from the Seaboard Construction Company, of Baltimore, were

also employed. The temporary trestle was built by the railway forces.

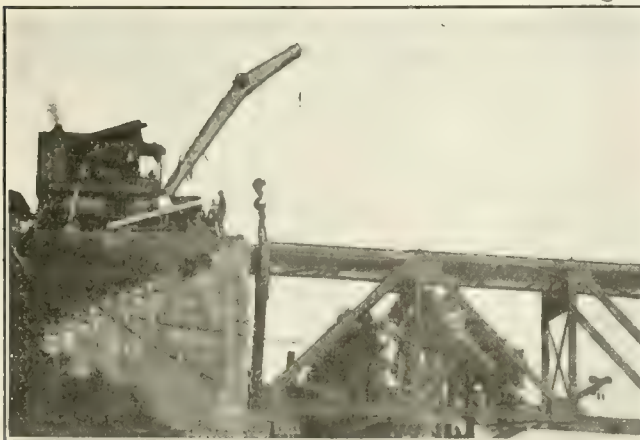
Since the track was opened for traffic the remaining steel spans, some of which were 500 ft. from the site, have been put back in place by the railway company's forces. The average time per span to do this was 4½ days, which included pulling the spans back to a point opposite the temporary track where they were to be replaced, raising them to the proper height, removing the temporary structure and shifting the span in position ready for traffic.

The spans that were farthest removed from the original site were brought back by the use of steam derricks and a Lidgerwood unloading machine. Before bringing the spans up, three lines of 7 x 16-in. stringers, three stringers to each line, securely bolted together, were laid from the spans to the bridge site. The spans were then turned over on these stringers, and heavy chains with long cable lines from the derricks and Lidgerwood machine were made fast and the spans drawn up opposite the point where they were to be replaced in the structure.

DERRICKS AND CRIBBING DO WORK

Derricks were then fastened to one end of the span, and this end was lifted 4 ft. above the opposite end, and after raising it the height mentioned, cribbing was brought up underneath. Then the derricks were transferred to the opposite end, which was raised 8 ft., making it 4 ft. above the end first raised, and this end cribbed up. This was continued, shifting the derrick from one end to the other until the bridge was brought to the proper height, 65 ft., after which well-oiled rails were placed underneath and the bridges set upon them. The trestle was then removed, and a derrick at each end alternately lifted one end and then the other until the bridge was in its proper alignment.

The minimum time required to take out the trestle and put the span in after it had been lifted to its proper height and the ties and rails placed upon it was two hours and fifty minutes, and the maximum time was three hours and twenty-seven minutes.



WRECKING CRANE LIFTS THE END SPAN

Housing of Better-Class Railroad Gangs Needs More Attention

Three Plans Show How Bridge-and-Building and Other Maintenance Men Can Be Given Better Living Quarters at Low Cost

By J. T. BOWSER

Maintenance-of-Way Department, Queen & Crescent Route, Danville, Ky.

THE LABOR problem in the railroad maintenance-of-way department is a question of many phases, and, after the rate of pay, the working conditions, or more properly the living conditions, determine to a great extent the quality of labor obtained and the success with which men are retained in the service. With some exceptions the quarters furnished for the bridge-and-building and extra gangs (with which this article will deal exclusively) consist of obsolete box cars more or less remodeled and equipped with bunks or other provision for sleeping; and in the opinion of the writer too little attention is given to sanitation, comfort and provision of space and after-work loafing and recreation.

Attention to these particulars is especially necessary on bridge-and-building, signal-department, and other gangs on which native white labor is employed. The majority of these men have homes, many have families of their own, and they have a right to expect something more than the ordinary box-bunk car, which under the best of conditions is kept sanitary and free from vermin with much difficulty. And having been used to moderate comfort and at least some social intercourse at home, they can hardly be expected to be entirely contented in cars where it is almost impossible to be comfortable and where no place is provided to spend the evenings after work, so that they must sit on the edges of their bunks or around the small stove in the restricted space in the center of the car. The more desirable men, particularly the mechanics in the signal and bridge-and-building departments, are steady men of family, not roisterers, and stay pretty close to camp.

A substantial betterment of these conditions can be obtained at a cost not at all out of proportion with the advantages to be gained, and in the accompanying sketches some suggestions along this line are offered. While the quarters usually provided for negro gangs and gangs of foreign laborers are far from ideal, their betterment is largely a question of ventilation and sanitation, and these sketches do not concern themselves

with cars for gangs of this character except for the foreman, since no radical change in the present construction is necessary to secure the desired results. For the mechanics and better classes of labor, cars of a different class are recommended. Numbers of old non-vestibule coaches are being replaced with coaches of more modern types, and few railroads are without several such cars, which should be available for conversion into camp cars for these gangs.

ACCOMMODATIONS FOR TEN

Fig. 1 is a sketch of a car for a bridge or carpenter gang, which under ordinary maintenance conditions consists of an average of eight or ten men. Thus in one car space is provided for the kitchen, dining-room, foreman's-room and sleeping accommodations for the men, and the entire camp outfit consists of one converted coach and one tool car, releasing two or more cars of the ordinary type. Both sides of the coach having windows for the entire length, sufficient ventilation is assured, and the dining-room affords ample space for



FIG. 1—FOR AN EIGHT OR TEN-MAN BRIDGE OR CARPENTER GANG

after-work loafing. Metal bunks, of which there are many types on the market, are more sightly, comfortable and sanitary than the wooden bunks, and these should be installed.

In this car, space is also allotted for the hand tools, which are usually the personal property of the mechanics, and each man is provided with a locker in which to keep clothes and other personal property.

FOR A LARGE BRIDGE GANG

For a larger gang, such as one on concrete work, or one on special bridge or building work requiring more than the usual number of men, a car designed like that shown in Fig. 2 would probably be found more satisfactory. While this car has sleeping capacity for only the same number of men as the car shown in Fig. 1, special provision is made for lounging space, so that a larger number of men can be accommodated. Sleeping quarters for the overflow could be provided in a car of the ordinary type equipped with metal bunks, or if enough old coaches are available, one of these equipped with bunks alone would accommodate a large number of men. A special car for kitchen and dining-room

would be necessary for a gang of this size. A converted box car would be entirely suitable for this purpose.

Fig. 3 is a sketch of an old coach designed for the foreman, assistant foreman and other white employees in charge of a gang of negro laborers, with space for

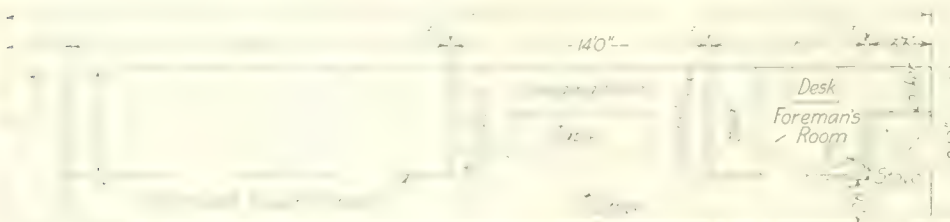


FIG. 2—FOR A LARGE SPECIAL BRIDGE OR BUILDING CREW

the lime treatment about a year ago and is now operating a new plant consisting of six tanks and sixteen contact beds covering 10 acres. At Brooklyn lime is used in the treatment of sewage at the Twenty-sixth ward pumping station. Sludge is spread over the low meadow lands, but plans are being made to abandon this plant and to substitute Imhoff tanks and sprinkling filters.

SETTLING TANKS AT PROVIDENCE

At Providence the sewage, after treatment with lime or with calcium hypochlorite, is settled in tanks. After settling it is stored and discharged with the ebbing tide. The effluent is only fair in quality. The cost of treatment by lime or hypochlorite was \$3.59 per 1,000,000 gal. The disposal of sludge is a difficult and expensive matter. It is first pumped by Shone ejectors to storage reservoirs, then by gravity to forcing reservoirs, from which it is forced under pressure of 60 lb. per square inch through large filter presses and finally is transported by cars to scows and carried 14 miles down the bay. The cost of sludge disposal in 1915 was \$3.01 per ton of dry solids. The superintendent, Mr. Bugby, stated that he thought the Providence plant, in service since 1901, would be the last of its kind. Experiments with activated sludge were being tried, but had not proceeded far enough to give conclusive results.

CHEMICAL TREATMENT AT WORCESTER

At Worcester during 1915 not quite two-thirds of the sewage was treated chemically. The remainder, the strongest part of the sewage, was treated on sand beds. One thousand and forty-eight pounds of lime was used per 1,000,000 gal. The sewage, after treatment with lime and thoroughly mixed, passed into six roughing tanks and afterward into ten finishing basins. The sludge is drained by gravity to a sludge well, from which it is pumped by a Shone ejector into two storage basins. The sludge presses did not have sufficient capacity to press all of the sludge and part of it was disposed of on old sludge beds. The remainder, after filter pressing, was carried on cars by trolley motor to a sludge dump, from which a considerable portion is removed by the farmers each winter. The cost of chemical precipitation was \$5.29 per 1,000,000 gal., and pressing was \$4.93 per 1,000,000 gal. During 1914 experiments were made with Imhoff tanks and sprinkling filters, with a view to their adoption either in enlarging the plant or in replacing chemical precipitation and sand filtration. The Worcester plant has been in operation since 1890.

NORWOOD'S TANNERY

At a tannery at Norwood was a waste more nearly resembling the starch-factory waste at Decatur than any sewage seen. A waste of 500,000 gal. several times as strong as ordinary domestic sewage is treated with sufficient lime to make it alkaline. After passing through settling tanks a portion of the effluent is applied to sand beds. The remainder is treated by dilution with water from an 800,000,000-gal. reservoir. When dilution water is too low it is oxidized by sodium nitrate. The sludge is transferred to drying beds. Part is carried off by the farmers, but part must be carted away by the owners of the tannery. The cost of the plant was \$100,000 and the annual net cost

\$30,000. This cost is considered excessive, and experiments have been carried on with Imhoff tanks and sprinkling filters. These tests show that a plant to handle the waste satisfactorily can be constructed for \$63,480. Preliminary experiments with activated sludge give sufficient encouragement to warrant their continuance on a larger scale.

The most difficult part of the operation of the lime-treatment plants was sludge disposal. Owing to the fact that the Decatur sewage would require approximately 3000 lb. of lime per 1,000,000 gal., there would be a much larger proportion of sludge to be removed than at either Providence or Worcester. Owing to the large amount of lime required, the fertilizer value would be less than at Providence or Worcester. The fertilizer value at either place is not sufficient to afford any income from the sludge. Rather it is an expense to dispose of it.

SCREENING ONLY AN AUXILIARY

Reinsch-Wurl screens were seen in operation at the Twenty-sixth ward station at Brooklyn. At the time of the visit, Saturday afternoon, the sewage was very weak and only a very small amount of suspended matter was being removed. The effluent from the screens, after passing sprinkling filters, was stable. Reinsch-Wurl screens were being installed at Rochester to remove the coarser suspended matter before the sewage entered the tanks. Each 12-ft. screen cost \$13,000 in place. At one of the stations in Cleveland not visited by the commissioners, Reinsch-Wurl screens were in use, but the proportion of suspended matter removed is very slight.

Observations would indicate that screening alone would not be suitable for Decatur conditions, but that it might be used to remove suspended matter should some form of tank treatment be adopted for the Decatur disposal plant.

TANK TREATMENT TENDS TOWARD IMHOFF STYLE

Septic tanks are being abandoned for the more modern Imhoff septic tanks. At Plainfield the old plant contains septic tanks which will be abandoned before the close of the present year. At Morristown septic tanks are still in use as preliminary treatment to contact beds, but this type is no longer to be recommended. The Imhoff tanks at Columbus are only partially completed. All of the sewage of the city was passed through ten tanks, which were greatly overworked, and which, because of the failure to complete the connection to the sludge-drying beds, contained too much sludge. The sludge had risen over the top of the gas vents and nearly covered the surface of the tanks. At Chatham, Imhoff tanks were used for the preliminary treatment before contact beds. The effluent, however, was not stable and could not be discharged into a small stream without further treatment. The sludge from the tanks was being dried satisfactorily on sludge beds. At Fitchburg five tanks have been in use about two years. The operation is satisfactory in preparing the sewage for distribution on sprinkling filters. The operation of the plant is good. At Rochester the Brighton plant, which contains tanks for preliminary treatment before sprinkling filters, was furnishing a satisfactory effluent for disposal on the

sprinkling filters at the time of the visit. This plant and the plants at Fitchburg and Plainfield are good illustrations of the best modern sewage-disposal practice.

Owing to the necessity for emptying Decatur sewage into the Sangamon River, which is practically dry during a considerable portion of the year, the tanks alone, which do not furnish a stable effluent, would require additional treatment by dilution or by secondary treatment.

SPRINKLING FILTER SIZE IMPORTANT

Sprinkling or trickling filters have a capacity about twice as great as contact beds and furnish an effluent as satisfactory. The size of filters required varies with the strength of the sewage. The plant at Columbus, where sprinkling filters followed septic tanks, was not entirely satisfactory. It is expected that when the new Imhoff tanks are entirely completed satisfactory results will be obtained.

The new plant at Plainfield is not yet in operation, but it is expected that it will give satisfactory results with the domestic sewage. The effluent of sprinkling filters at Fitchburg, after passing through a secondary settling tank, is uniformly stable.

With secondary settling tanks a very clear, stable effluent was obtained at the Brighton plant at Rochester.

EXPERIMENTAL PLANT AT NORWOOD

An experimental plant at a tannery at Norwood has shown that sprinkling filters following Imhoff tanks would take care of tannery wastes at a rate of 500,000 gal. per acre per day.

The Imhoff tanks and sprinkling filters followed by secondary sedimentation would be suitable for Decatur conditions, states the report. Because of the starch-factory wastes it will be necessary to furnish a larger area of beds than would be necessary for domestic sewage alone. Probably an area of beds between that used at Plainfield, Fitchburg and Rochester and less than that used in the experimental plant at the tannery at Norwood would be needed. It seems unfortunate that experimental tests at Decatur could not have been carried out when the starch factory was in operation, so that the efficiency of tanks and filters in treating the mixed starch-factory wastes and domestic sewage could be determined.

SAND-FILTER EFFLUENTS GOOD

Very satisfactory effluents can be obtained from sand filters. These were seen at Chatham, following Imhoff tanks and contact beds; at Morristown, following septic tanks and contact beds, and at Worcester, following settling tanks. Sand beds are also used at Walpole for the treatment of part of the waste from a paper mill, and at Norwood for part of the waste from the tannery.

Because of the large area that would be required for the domestic sewage at Decatur, and owing to the absence of sand deposits in the neighborhood, treatment of Decatur sewage on sand beds seems impractical.

At Brooklyn experiments with activated sludge have given promising results. The process will be studied with a view to its possible adoption at Coney Island and Rockaway.

At Providence an experimental plant was seen in which it is proposed to determine whether it would be practical to replace the chemical precipitating tanks by the activated-sludge process. It is thought that the present chemical tanks could be modified into activated-sludge tanks if the process proves economical.

At Norwood preliminary experiments have been completed with sufficient promise to warrant a continuance of the experiment. Either activated-sludge or Imhoff tanks with sprinkling filters will be adopted for a new disposal plant at the tannery.

ACTIVATED-SLUDGE PROCESS

At Cleveland 500,000 gal. of sewage is being treated daily by the activated-sludge process in a tank only 20 x 60 x 14 ft. deep. No attempt is made to obtain a perfectly stable effluent. Owing to the dilution in Lake Erie, an effluent which is stable for two days is considered satisfactory. The cost of air for the treatment at Cleveland is stated to be \$3.75 per 1,000,000 gal. with air at 0.75 cent per kilowatt-hour.

If the city of Decatur can obtain power for less than 1 cent per kilowatt-hour, and if an effluent containing no suspended matter that would be stable for two days would meet the requirements of the Rivers and Lakes Commission, it would seem as though the activated-sludge process might be considered for the disposal of Decatur city sewage. This seems especially suitable for Decatur conditions, owing to the presence of the starch-factory waste. This waste has a concentration of from five to ten times that of domestic sewage and an organic content approximating the packing-house wastes of Chicago, for the disposal of which activated sludge has been recommended.

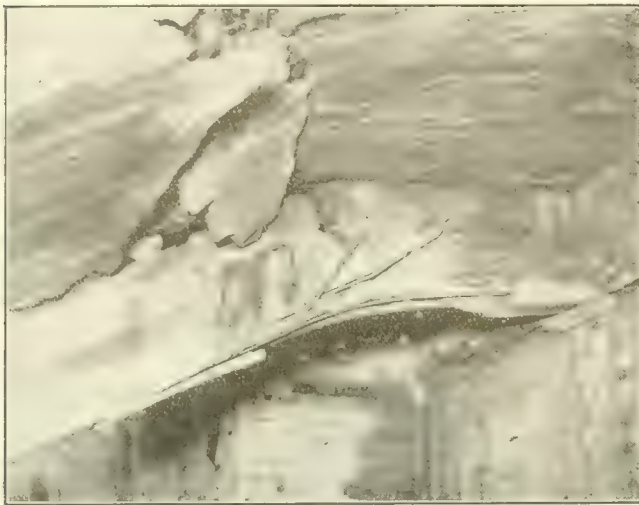
DISPOSAL OF SURPLUS SLUDGE

The problem of disposal of surplus sludge from the activated-sludge process has not yet been satisfactorily solved. At Brooklyn it is proposed to aerate and settle and decant the supernatant liquid, repeating this process until only humus remains. At Cleveland the disposal by the centrifuge used in laundries has not been found satisfactory. Disposal on sand beds under cover, after continuous aeration of the sludge for several days, has been found possible, but further experimental work is desired before it can be declared practical. Experimental work on sludge disposal is being carried out at Chicago, Milwaukee and at the University of Illinois. Therefore more definite information should be at hand at an early date.

S. A. Greeley and Langdon Pearse, the consulting engineers who made the original experiments at Decatur, have been re-employed to assist Mr. Hicks, city engineer, on the interceptor and the general problems as they develop.

Economy Forces Paving of Fords in Arizona Over Washes

Fords over shallow washes in Arizona to obviate a high-grade line and to reduce the expense of bridges are made of 8 and 10-in. rock laid by hand and grouted in with cement mortar. A 2-in. wearing surface of concrete is placed on top. Curtain walls extend below the paving to prevent scour.



EXPOSED STEEL IN BEAM OF FOURTH FLOOR WHICH FAILED

Quartz-Gravel Aggregate Blamed for Excessive Fire Damage

Reinforced-Concrete Warehouse Fire at Far Rockaway, N. Y., Investigated by Ira H. Woolson—Fire Enters at Small Holes

AFTER a thorough investigation of the excessive damage to the structural framework of a reinforced-concrete warehouse caused by a relatively low-temperature fire on Nov. 10, 1916, Ira H. Woolson, consulting engineer to the committee on construction of buildings of the National Board of Fire Underwriters, has just issued a 31-page pamphlet in which he concludes that the principal cause of the damage can be traced to the use of pure quartz-gravel aggregate. Previous tests of similar concrete are cited to show that disintegration at comparatively low temperatures may be caused by the relatively high coefficient of expansion of quartz, and more complete investigation is called for. In proportion to the probable intensity of the fire, the damage greatly exceeded the memorable Edison fire reported in the issue of Dec. 19, 1914, page 660, for which methods of repair were described in subsequent issues. The following abstract of Mr. Woolson's report includes the principal lessons from the spread of the fire and the striking conclusions in which explanation of the excessive damage from minor short flash fires is offered.

FIRE SPREADS THROUGH SMALL HOLES

The fire started in a three-story frame woodworking shop, which was entirely destroyed, and was transmitted to the contents of the adjoining seven-story reinforced-concrete building on White Street, Far Rockaway, owned and operated by Mullen & Buckley and used for furniture storage and repair and for light manufacturing—window screens, chair seats, etc. The fire evidently spread to the inflammable contents of the warehouse through very small holes in the 8-in. concrete wall—in the first floor through a 5-in. hole used for a tube of an interior carrier system and through a 1-in. hole in the west end to a pile of kindling wood, starting a light surface fire; in the second floor probably through $\frac{1}{2}$ -in. openings around a poorly fitting fire-door; in the fourth floor through a 1-in. hole or around

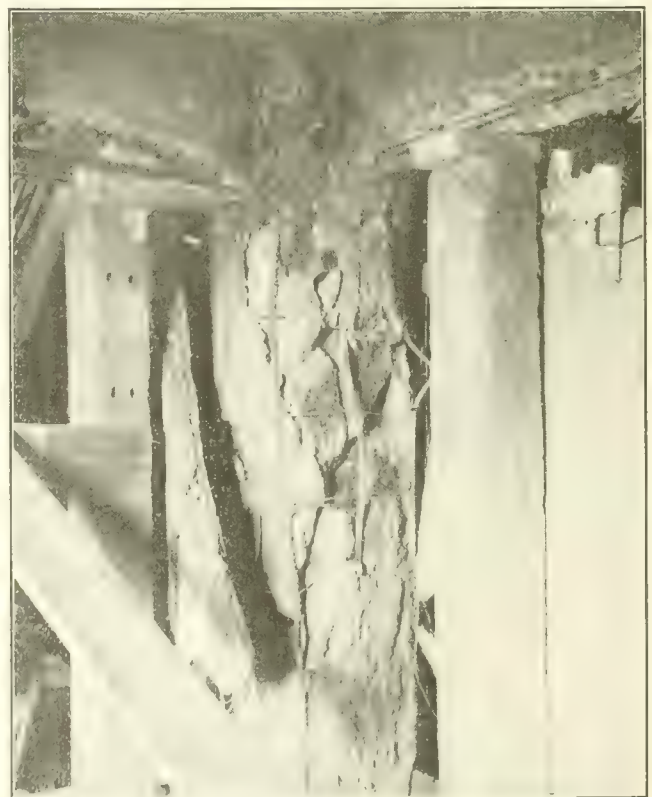
a brick wall, and in other upper floors possibly through fused glass of the windows.

The concrete building, 52 x 90 ft. in plan, was of girder, beam and slab construction, with one row of square columns down the center, giving panels about $17\frac{1}{2}$ x 26 ft. The design was made by the Trussed Concrete Steel Company and the building was erected in 1909 by the Industrial Engineering Company. A mix of 1:2:4 stone concrete was specified and quartz-gravel aggregate generally 1 in. in size was used, but some $2\frac{1}{2}$ -in. stone were found in the damaged structure. The columns are reinforced by vertical rods and round ties on 12-in. centers, with concrete protection varying from $1\frac{1}{2}$ to 3 in. Floor slabs varied from 4 to 6 in. in thickness, with an upper surface finish $1\frac{1}{2}$ to 2 in. thick cast subsequently, which separated when the floors deflected. Expanded rib reinforcement with 4-in. mesh was used for these slabs in sheets 32 in. wide, with spaces 2 to 4 in. between sheets, and little concrete protection was furnished the steel—generally only $\frac{1}{8}$ to $\frac{1}{4}$ in.

Girders and beams were reinforced by Kahn trussed bars. In the part of the fourth floor which failed, the negative reinforcement for the beams was near the bottom instead of the top of the floor slab, and in both girders and beams it was found that the ribbed bars sometimes touched each other, instead of being spaced properly. Concrete $\frac{1}{2}$ to $1\frac{1}{2}$ in. thick protected the bars.

RESULTS OF THE FIRE

The pamphlet contains an exhaustive discussion of the results of the various fires on each floor of the concrete building—their nature and the effect on the con-



INTERIOR COLUMN FAILED AND UPPER FLOORS SETTLED
Located near the rear of third floor. This column was subjected to high temperature from burning oil in the vicinity.

crete. Striking evidence is presented of large structural damage due to minor short flash fires, in addition to the complete failure of the fourth-floor slab and one column in the rear in the vicinity of the hot fire caused by six or eight barrels of inflammable liquids stored in an oil and varnish room at the northwest corner. Melted copper and brass in this vicinity indicate temperatures from 1600 to 2000 deg. Fahr. An interior column, shown in one of the photographs, was completely shattered and failed by diagonal shear, with bulging of the reinforcement. Three overhead beams fell, carrying with them the adjacent floor slab of three panels near this corner. The slab broke away from the collapsed beams and hung in separate sections, caused by lack of overlap of the slab reinforcement, the sheets of which were not wired together as specified in the design. The collapse did not occur until some time after the fire was extinguished.

FLOOR SLABS NOT BADLY DAMAGED

Aside from numerous cracks, the floor slabs throughout the building are not badly damaged, although the steel was poorly protected by concrete. The cracks contributed largely to the water damage, and their appearance indicates that a fair proportion may have existed for some time before the fire. The many cases where minor fires occurred (the work of firemen evidently being effective) a relatively large amount of spalling and disintegration of the concrete was evident. For example, in the first floor chunks 8 and 10 in. thick fell from a girder, and bars in the bottom were exposed for 15 ft. in length.

The exposed south wall, subjected to the full force of the fire in the woodworking factory, is badly spalled;



REAR PANELS OF FOURTH-FLOOR SLAB FAILED

Exposed steel and unburned timber are characteristics of this fire

spots several square feet in area and 2 to 3 in. deep are seen, but no reinforcement was exposed, as it was probably placed near the inner surface of the wall. The wall is wavy at the fourth and fifth stories and several noticeable cracks are seen. The west wall is bulged outward 1 in. or more and there are numerous cracks, one of which zigzags completely across the building at about the fourth floor level.

GENERAL CONCLUSIONS

The important conclusions from a study of this fire given in the report in addition to the first, which emphasizes the fact that a suitable sprinkler system would have saved the building, are the folly of erecting high-grade fire-resistive structures and then allowing small unprotected openings in walls and floors which permit inflammable contents to catch fire, and the deficient concrete protection for steel involved in the use of pure quartz-gravel aggregate which disintegrates under heat.

In this conclusion reference is made to the author's investigation on thermal conductivity of concrete and the final report in the *Proceedings* of the American Society for Testing Materials for 1907. Experiments are cited to show disintegration of quartz-gravel concrete under relatively low fire temperatures, probably due to the large cubical coefficient of expansion of quartz (about twice that of feldspar), and the conclusion is quoted "that the gravel concrete was not a reliable or safe fire-resisting aggregate"—a restriction which applied only to pure quartz gravel such as is found in the vicinity of New York City, similar to that used in this building. It is stated that subsequent investigations by the British Fire Prevention Committee of England confirmed these findings for a similar quartz gravel there.

If this explanation is correct, it is stated that all concrete specifications should contain a definite warning against the use of quartz gravel in concrete liable to be exposed to high heat.

Among other final conclusions are emphasized the advantages of fire-resistive partitions (even pine-board partitions prevented this fire from spreading in two cases), the destructive action of quick fires on structural members with sharp corners, such as square columns, the prevention of water damage by using water-proofed floors, and the fact that storage of inflammable liquids inside a building should never be permitted.



SOUTHWEST CORNER—VIEW SHOWS SPALLED CONCRETE ON SIDE AND CRACKS IN WEST SIDE

Volcanic Heat Drives Electric-Power Plant in Italy

Utilization of Steam Jets Issuing from Ground in Developing 15,000 Horsepower Has Overcome Scarcity of Coal

VOLCANIC HEAT is now being used successfully in the development of 15,000 hp. near Larderello, a village in Tuscany, Italy. The first of three 3000-kw. groups of turbo-electric engines driven by steam issuing from the earth's interior was put into service in January, 1916, the second in April and the third this fall. The power is transmitted electrically to Florence, Leghorn and numerous other cities and towns in Tuscany, supplying industries that had been crippled since the war by the scarcity and high price of coal.

Near Volterra, in central Tuscany, there are numerous cracks in the ground, from which powerful jets of very hot steam spout high in the air with great violence and constancy, bringing up boric acid and other substances of less importance. These jets have been utilized for many years in the production of boric acid and borax, and occasionally for warming houses in the near-by village of Larderello. Most of the steam, however, was lost.

FIRST USE OF VOLCANIC STEAM

The first use of this superheated steam for the production of motive power was made in 1903. Prince Ginori-Conti, president of the Societa Boracifera di Larderello, first applied a strong jet to a small rotary motor, then to a small reciprocating steam engine connected to a dynamo, which generated enough current to light part of the borax works.

Meanwhile, to get a more ample supply of steam he bored holes in the ground to the source of the steam, which is under a hard stratum of rock from 300 to 500 ft. below the surface. The holes vary from 12 to 20 in. in diameter, and are lined with iron pipes. They give forth steam at a pressure of from 2 to 3 and occasionally up to 5 atmospheres, and temperatures varying from 150 to 190 deg. C. These jets have not diminished in their activity, and new borings do not interfere with the preceding ones provided they are at least 50 ft. apart.

APPLICATION TO STEAM ENGINE

In 1906 Prince Ginori-Conti applied the steam to an ordinary steam engine of about 40 hp. The salts and gases were found to be very destructive of the iron parts of the engine, but this difficulty was avoided by applying the superheated steam to a boiler in place of fuel. In this way, a 300-hp. condensing steam turbine was made to supply the works and villages around Larderello.

After the outbreak of the war coal became very scarce and prices became prohibitive. Prince Ginori-Conti determined, therefore, to try a much more extensive use of the natural steam. Three groups of condensing turbo-electric engines were installed, each of 3000 kw., working with superheated steam at $1\frac{1}{2}$ atmospheres, generated in specially constructed multi-tubular boilers. As in the earlier installation, the natural steam is used instead of fuel. In heating the boiler it is re-

duced from 180 to 120 deg. C., and is then utilized for the borax industries. The steam for the boilers and turbines is ordinary water steam, which on its way to the turbine passes in pipes through superheated natural steam, thereby itself becoming superheated to about 150 deg. C. After working in the turbines the water steam is condensed and returned to the boilers.

The triphase electric current is generated at 6500 volts, transformed to 36,000 volts and delivered to Florence, Leghorn, Volterra, Grosseto and many smaller towns of Tuscany, where it is used mainly as motive power for munition works during the day time and for lighting at night.

As the region of the steam jets extends for many square miles around Larderello it is believed that the transforming of volcanic heat into electric power can be increased to hundreds of thousands of horsepower.

The foregoing information was furnished by Prof. Luigi Luiggi of the University of Rome, president of the Italian Society of Civil Engineers.

Five New Piers for San Francisco This Year

Construction Program for 1917 Is Announced by State Harbor Board—At Least Four of the Piers Will Be All Concrete

THE construction program for 1917 as recently announced by J. J. Dwyer, president of the Board of State Harbor Commissioners of California, includes five new piers ranging in width from 138 ft. to 200 ft. and from 550 ft. to 800 ft. in length. Four of these will be of all-concrete construction and the fifth is still under consideration by the chief engineer.

A distinctly new phase of improvement will be the pavement of a 30-ft. strip for the entire length of the waterfront under the jurisdiction of the commission. This will be especially for the use of automobiles and light vehicles of all kinds. The pavement will be of the most durable construction—a 6-in. concrete base surfaced with a 3-in. asphaltic top dressing. The basalt pavement on the remaining width of the street will be left undisturbed.

IMPROVEMENT OF CHINA BASIN

Surveys are now under way for the improvement of China Basin, where bulkheads, wharves and piers are contemplated. This work, which is now in the preliminary survey stage, involves an improvement of the shore line between Channel Street and Pier 54. Designs are to be completed in the spring and work well advanced during 1917. At various points along the waterfront an unusually large number of buildings are to be constructed this year, including structures on shore and on piers. The commission has now established the policy of having the design of all structures prepared by the architect. This assures a pleasing and harmonious general appearance of the harbor works without any material cost increase.

The five piers will cost a total of between \$2,000,000 and \$3,000,000. All the work will be designed and carried out under the direction of Frank G. White, chief engineer of the State Harbor Commission.

On the Mexican Border with the 22d Engineers

Part II—Damage to Rain-Soaked Earth Roads by Heavy Motor Traffic Repaired —65 Square Miles of Territory Mapped—Possibilities in Use of Equipment

By C. E. BREGENZER

First Lieutenant, 22d New York Engineers, N. G. U. S.

TEXAS roads in the vicinity of the military camps at the border are of earth, indifferently crowned and ditched. They were sufficient for the light vehicles which were in use, but the advent of the troops with their equipment, and particularly the heavy motor trucks, together with the rainy season, soon caused rutting, soft holes, and wear. Prior to the arrival of the troops it had not rained for fourteen months.

RAIN AND TRAFFIC DAMAGE ROADS

The worst road conditions were naturally encountered between the quartermaster's depot, located near the McAllen freight station, and the various camps. The road leading from Pharr through McAllen to Mission was also in bad shape. While most of the roads were hub deep in many spots during the greater part of the rainy season, the lower valley points were submerged. It became necessary to make detours through the fields. A contractor who had a scraper outfit was employed to fill in the low spots and grade that part of the Hidalgo road, from the McAllen-Mission road, which led to the Squadron A camp. Traffic on these roads was very heavy, as the various outfits, particularly those having stock, had to make frequent trips to the quartermaster's depot for supplies.

An observation of the action of rain and the condition of the roads seemed to dictate the necessity of high crowns and ample ditches to insure quick runoff of water and ditch capacity to handle it. Observation of roads at summit points apparently confirmed this, and consequently this was the method followed in construction. Crowns were made 1 ft. high, and the ditches averaged from 1 to 3 ft. The bad feature of this construction is that it confines traffic to the center of the road. The ditches were plowed and the excavated soil was taken to the center of the road with Fresno scrapers, and was then surfaced after a manner. No rollers were used. This helped to make roads better in a degree, but the motor trucks soon succeeded in churning holes, especially when they used tire chains. Used after rains, the earth surface seemed to lose all bond and simply degenerated into slush.

ROAD SURFACES

Roads subjected to such heavy traffic require a base and a metalled surface. A report advocating the use of Sam Fordyce gravel for surfacing was made to the U. S. engineer officer in charge of the Brownsville district, and 10,000 cu. yd. was shipped. This was employed largely on one of the much-used regimental thoroughfares. It was spread to a depth of about 2 in., and was well watered down by providential rains. This proved a considerable improvement. It remained a matter of speculation among the engineer officers if it would not have been more profitable to run railroad spurs into the various camps, or at least industrial railroads, especially as liberty could have been used on

gradients, for the trains would not have exceeded three or four cars at a time. Military engineering practice in Europe would seem to substantiate this method of handling supplies.

The road work done by the engineers was necessarily confined to repair work. There were many exceptionally bad spots which required immediate attention. Pick-and-shovel equipment does not offer a large range



MORE THAN 1,000,000 FEET OF LUMBER WAS USED FOR STRUCTURES

on road work. Most of these repair jobs consisted of bad soft spots where vehicles and motor trucks were constantly mired. A detail of engineers dug one of these out. It was 5 ft. deep, 8 ft. wide, and 15 ft. long. When the apparent bottom was reached it developed that water was seeping in from a neighboring irrigation canal which was diked at this point. To aggravate matters, the ditches were full of water, and there was no possible point to drain to. Repairs on this road were accomplished by building a corduroy section over the freshly filled hole and topping off with fresh earth. The ditches were extended up a near-by cross-road and deepened. The whole road was raised about 3 ft. and rolled down by a roller improvised from a 3 x 6-ft. wooden cable drum filled with earth. The corduroy method was resorted to on other occasions where quick repairs were necessary.

The addition of a topographical engineer officer, under the new table of organization for engineer regiments, and the addition of master engineer sergeants,

attached to regimental and battalion staffs, gave the work of map-making considerable impetus. A complete military topographical map, showing all data required for tactical purposes, and comprising an area of 65 square miles, was completed. At the present writing this has been extended some 20 miles west of McAllen, as far as Los Ebanos, the whole making a collection of valuable data. Roads were used as controls, which in turn formed base lines for development. The roads in this section are practically all located on meridians



A COMPLETE SYSTEM OF MODERN TRENCHES WAS FIRST TRACED WITH TAPE AND THEN DUG

and parallels, which facilitated the work to a degree. One of the mess shacks was fitted up as an engineer office, and here all drafting, zincograph reproduction, blueprinting and photographic work was carried on. Most of the maps were made with the military plane-table, although in some cases compass, transits, regular plane-tables and cavalry sketching cases were resorted to. Many of the men qualified in this important branch of military engineering.

In addition to topographical maps, drawings were also made showing source of water supply, pipe lines, valves, connections and fittings for every camp in the entire New York Division. At the time of the outbreak of paratyphoid, special maps giving all camp details were furnished, and an engineer soldier was attached to headquarters on the medical staff for progress work. Engineer soldiers on the march, on finding new or unmapped roads, strapped an odometer on the wheels of an escort wagon and took bearings with a compass.

TRENCH WORK

A complete system of modern trenches was traced and constructed in a field adjoining the engineer camp. The dimensions were of a size to accommodate one company. The first-line trenches were mostly of the one-squad traverse type, and were connected by communicating trenches to dressing stations, bombproofs, latrines, overhead shelters, and other features dictated by most modern practice. The execution of this work was the daily engineer drill of such engineer troops as were not otherwise detailed. The men, besides familiarizing themselves with the various types, were also instructed in the proper use of tools.

In front of the trenches a complete system of barbed-wire entanglements was constructed, together with other types of obstacles. A trip wire system was also installed to prevent night surprises and attacks. On approaching the entanglements the enemy could not avoid contact with the wire, which automatically released a device, which in turn exploded flares provided with reflectors, outlining all approaching in strong silhouette, and bringing them under direct field of fire of the trenches. Mortars were also constructed having a sector of from 40 to 60 deg., from which illuminating bombs were fired which lighted up the entire field. Several night maneuvers proved the success of this work.

The entire system of defense was used as a school of instruction for members of the various infantry units, who attended lectures by engineer officers and were taught how to trace and dig trenches efficiently.

STRUCTURES

At the time the writer left the border (Oct. 12) it was estimated that more than 1,000,000 ft. of lumber had been used in structures for the various units located at McAllen. This included the buildings for the base hospital, mess shacks, quartermaster's storehouses, showers, regimental supply houses, tent floors, and tables and benches. Plans were United States standards furnished by the quartermaster's department at Fort Sam Houston, San Antonio. An engineer officer, with title of construction engineer, was detailed to headquarters on this work, to make estimates on materials of construction and also allotments of lumber to the various regiments. The man appointed to this office was a prominent New York engineering contractor, and so closely did he estimate that the cooks had little left for kindling wood. The various structures were built by contract, or by the men from the various units, under the supervision of an inspector furnished by the engineers.

MESS SHACKS

The greatest comfort accrued to the men from the mess shacks, which were 20 x 64 ft., with a 16 x 20-ft. kitchen on one end. In type they were very similar to contractors' shacks used on construction work, only the walls were screened entirely. The roof was of 1/8-in. shiplap, covered with roofing paper and supported by a Warren roof truss. The construction of these structures gave the men considerable experience in the use of tools.



SLUICE GATE BUILT BY ENGINEERS

Of sanitary measures there were many, but the enviable health record easily justified them. One of the most important of these was the incinerator for destroying kitchen refuse. For the construction of this the quartermaster's department furnished brick, cement, sand, a Sibley stove, and steel pan. The ordinary method of construction was to build two walls, two bricks thick, 15 ft.

long, 3 ft. wide, and about 2 ft. high, with a 2 ft. chimney on one end, topped off with the Sibley stove for a stack. The steel pan, used for liquids, was placed over the walls and a fire lighted underneath. The solids were thrown on the fire. The government furnished mesquite wood. This type was so voracious of wood that the cooks began complaining about shortage.

Experiments were then made by the engineers, the basis of which was furnished by boiler-furnace construction. An ashpit and firebox, with pipes for grates, were constructed on one end, and the air space was reduced to 6 in. under the pan by means of a brick baffle and earth filling. Over the firebox grate another pipe grate was constructed, upon which solids were deposited. This type reduced the consumption of wood 75 per cent, and the incineration of the offal of one mess was accomplished in two hours. To prevent carbonizing of the pans, screened frames were placed over them, allowing nothing but liquids to go through. Some very artistic brickwork was secured on these incinerators. A bricklayer was discovered among the engineers who had done work of so fine a character that he laid only eighty brick a day.

SLUICE GATE REPLACED

Seeking after comfort is one of the unwritten laws of the soldier, and in pursuit of it sluiceways and water gates on a neighboring ranch suffered, according to claims by the owner. At all events, the engineers were ordered to rebuild them. The sluiceways were 4 x 6 x 18 ft., with a side outlet 4 x 6 x 7 ft., requiring two gates 4 x 6 ft. This was a good example of a military engineer working with materials at hand, for nothing was available but 1 x 10-in. by 16-ft. sheathing and 2 x 4-in. lumber. The walls were rebuilt of the sheathing, nailed to 4 x 4-in. studs and liberally braced. The gates were built of the 1-in. material, but to withstand pressure they were stiffened by cleats and 2 x 4-in. ribbing set on edge. A mechanical hoisting device was constructed by making a 6-in. diameter drum, which was operated by three 2½-ft. handles on each side, and fastened to one side of the 2 x 4-in. standards. By this means the gates were raised without difficulty, and the owner was satisfied.

In addition to the engineer work described, the engineer troops were obliged to perform infantry drill, do guard duty, participate in reviews, and follow closely the curriculum prescribed for infantry soldiers. The



EARTH ROADS, SATURATED BY RAIN AND SUBJECTED TO HEAVY MOTOR-TRUCK TRAFFIC, SOON REQUIRED REPAIRS

officers and a mounted section from each company were also required to do cavalry drill. To defend what he has constructed the engineer soldier must also be a good shot.

ORGANIZATION AND EQUIPMENT

Under the new table of organization an engineer regiment consists of two battalions, of three companies each, with a colonel, lieutenant-colonel, two majors, three adjutants, one supply officer, a topographical engineer offi-



A COMPLETE TOPOGRAPHICAL MAP WAS MADE COVERING AN AREA OF 65 SQUARE MILES

cer, six captains, twelve first and six second lieutenants for company officers. The new grades of senior and junior master engineer sergeants have also been established. Among the officers who served with the 22d New York Engineers on the Mexican border were two West Point graduates who had served with engineers, three who had participated in the Philippine campaigns, and civil engineers who had worked in Mexico, India, and other tropical and semi-tropical climates.

COMBAT TRAIN

The combat train referred to in this article is very similar to a contractor's tool box mounted on a wagon gear. It is rendered readily accessible by openings on the top, sides and rear. The battalion combat train contains transits, levels, plane-tables, level and stadia rods, range poles, plumb-bobs, steel and metallic tapes, drawing tables, instruments and supplies, and generally the same class of articles as go to make up a field engineer's equipment. The company combat train contains compact plane-table outfits, cavalry sketching boards, photographic outfits, drawing tables and instruments, field books and stationery, lanterns, portable acetylene lighting outfit, picks, shovels, spades, mattocks, axes, crow and pinch bars, sledge hammers, wrenches, complete set of carpenter's tools, jacks, explosives, fuse, batteries, nails, bolts, chisels, hacksaws, etc. A separate field-battery wagon for explosive work, a map-making wagon, and a zincograph outfit for rapid reproduction and multigraphing are also furnished. In addition, the regiment is equipped with escort wagons and a light advance pontoon train.

Perhaps, in the spirit of preparedness, many readers

will see a close parallel between the work of the military engineer and that of the engineering contractor. Both must be adept in the handling of men and equipment. The value in military engineering of field-construction experience, the handling and housing of men, cannot be overestimated. The engineering contractor would lean more toward the use of equipment than is common in present military practice. He would consider caterpillar tractors, trench pumps, and other portable pumps for water supply, portable compressors and drills, road machinery, portable lighting outfits and refrigerating plants, trench excavators, welding and cutting apparatus, concrete machinery, small hoists and gasoline engines and saw rigs. It may be advanced that these would militate against mobility; but they would make for time and comfort. On the mobility point the motor truck appears as a factor. It has many advantages, but the army mule is still reliable.

Present European experience seems to favor the larger use of plant and equipment for military work. If the combat train in use in this country were incorporated in a motor truck, more space would be gained, a winch could be fastened to the hubs, and a collapsible steel derrick could be added from which a small type of pile hammer could be suspended. It cannot be gainsaid that in the American engineer and engineering contractor this country has a splendid reserve, whose scope of action in time of war has probably not been fully realized.

Wisconsin Methods of Gravel-Road Construction Explained

Substantial Foundation, Careful Gravel Selection, Crushing of Oversize, Even Spreading and Early Maintenance Are Essential Features

GRAVEL roads so well constructed that they wear almost as long as macadam were described by J. T. Donaghey, chief inspector of the Wisconsin Highway Commission, in a paper presented before the Northwestern Road Congress, the source of the following notes.

Surveys, plans and cross-sections for gravel roads are the same as for other types of surfacing, and standard concrete culverts are built. The grade is made somewhat wider than necessary for the present gravel surface so as to accommodate a wider surface when traffic conditions demand it. No sod or vegetable matter is allowed under the surfaced portion. Where necessary, underdrainage is provided and just as good a foundation is insisted upon for gravel road as for any other type, since it is impossible to get a good surface on a poor foundation. The subgrade is prepared by cutting out a trench the full depth and width planned for the finished surface and having the same crown. Wide drains are constructed to insure a dry subgrade in the event of rains during the course of construction. On clay soils the subgrade is rolled before placing the material, the purpose being to develop the weak or soft spots, if any.

In building a pit-run gravel road the large stones are removed at the pit, preferably by the use of an elevator and screen. Gravel is delivered to the elevator by wheelers or Fresno's. If extreme care is used the large

stones may be removed at the time of loading by the use of five or six-tine forks. The latter method is not recommended and is satisfactory only on small jobs.

Loads of exactly the same size in length, width and depth should be hauled. It is essential that they are dumped so that each covers the same length and width, insuring an even depth of material. To use uneven loads with the ordinary method of spreading is sure to result in an uneven surface.

GRAVEL ROADS BUILT IN TWO COURSES

Practically all gravel roads in Wisconsin are built in two courses plus the binder necessary, spreading the first course evenly to a loose depth of not to exceed 6 in., and generally beginning at the end nearest the pit and hauling over the material as the work progresses. This method saves some rolling.

The first course is gone over several times with a road plane or light grader, with blade set nearly at right angles, to insure an even surface before rolling. After properly rolling the first course the second course is started at the farthest end from the pit and work progresses toward it. The material is spread to a loose depth of about 5 in. and harrowed thoroughly with a heavy peg-tooth harrow before rolling. Most pits run uneven, but the harrow will tend to mix the material and will also bring the coarse stone to the surface where it can be raked off. If the gravel will not bind readily it may be necessary to harrow in clay to help in bonding, which can be done at the same operation; but care must be exercised in the application of clay, because an excessive amount may cause the surface to rut during wet weather. A light grader is used a sufficient number of times to insure the removal of all wavy appearance and give to the surface a proper crown.

SECOND GRADING OFTEN NECESSARY

It is often necessary to use the grader a second time after the rolling has been started to remove the wavy appearance. The voids in the surface, if any, are filled with fine gravel, then the road is rolled thoroughly and flushed.

Better results may sometimes be obtained by thoroughly wetting the material and allowing it to dry to such an extent before rolling that the binder will not pick up on the wheels of the roller. This method insures the proper bond from the bottom up. It is difficult to advise as to the proper amount of water for a pit-run gravel road, as no two sections can be treated alike. If possible, the road is opened to travel while the roller is yet on the job, and if ruts appear they are filled at once by using the light grader or road plane and roller until thoroughly compacted. Provisions are made for following up with maintenance immediately if necessary, as well as surface treatment when the surface becomes well cured.

CRUSH AND SCREEN LARGE SIZES

In many eastern and southern counties in Wisconsin are numerous gravel pits of excellent quality, but they usually contain a rather high percentage of large stone, and many contain an excess of binder. To handle this particular kind of gravel economically and get the very best results, it is found necessary to crush and screen it. An ordinary portable jaw crusher, with screen and

bins, having a capacity of from 80 to 120 cu. yd. per day, is used. Usually the plant is equipped with a conveyor and grizzly screen which removes the fine material and transfers it to the elevator, allowing only the coarse stone to pass through the crusher jaws. This procedure increases the capacity of the crusher from 20 to 40 per cent.

CRUSHER PLANT

The crushers are equipped with a three-compartment portable bin of 35 to 50 cu. yd. capacity and a two-section screen, each section being 30 in. in diameter and 4 ft. in length. The first, or lead, section has $\frac{1}{2}$ -in. perforations and the second section $1\frac{3}{4}$ -in. perforations, thus separating the material into three sizes. The No. 1 size consists of material refusing the $\frac{1}{2}$ -in. ring; the No. 2 size the material refusing the $\frac{1}{2}$ -in. ring and passing the $1\frac{3}{4}$ -in. ring; the No. 3 size the material passing through the $\frac{1}{2}$ -in. ring. The crusher jaws are adjusted so as to produce about equal proportions of the No. 1 and the No. 2 sizes.

The subgrade is prepared as described for pit-run gravel, but construction is started at the end of the road farthest from the gravel supply. The first course consists of No. 1 material spread to a loose depth of about 6 in., and well rolled, the voids having been filled with the necessary amount of No. 3 material. This course is laid for a distance of about 400 ft. before starting the second course.

SECOND COURSE

The same care is exercised in having uniform loads delivered and evenly spread. The second course consists of about 5 in. of No. 2 material, evenly spread and rolled, the voids being well filled with No. 3 material. The surface is brought to the proper crown with a light grader and then thoroughly rolled and flushed in practically the same manner as is a stone macadam road.

Some pits contain quite a percentage of clay, and in this case a heavy harrow is used to work in the No. 3 material, thereby greatly benefiting the finished road. In some cases there is a surplus of No. 3 material which is distributed at convenient points along the road for maintenance purposes, or used for surfacing private entrances or road intersections.

GRADING OF MATERIAL

In many instances better results are obtained by crushing the gravel fine enough for practically all the material to pass through the $1\frac{3}{4}$ -in. ring. In this case it is the practice to carry over into the No. 2 material just enough of the No. 3, or bonding material, to fill the voids in the No. 2. This is accomplished by placing a sheet-iron jacket around the lower three-fourths of the first section of the screen, which does not permit all the finer material to pass through the $\frac{1}{2}$ -in. perforations but carries the necessary binder over into the bin with the No. 2 material. This must be regulated so as just to fill the voids in the No. 2 material with the No. 3, and no more. The remainder of the No. 3 material will naturally drop into the No. 3 bin and may be used in finishing the surface where additional binder is required, or for future maintenance and other purposes. By pursuing this method, both first

and second courses are built of the same sized materials, resulting in a type of road which is easier to build, cheaper to maintain and one which generally gives better satisfaction than any other type of gravel road. Where clay is used to assist in binding, or where there is naturally an excessive amount of clay in the gravel, it is advisable to place a covering of sharp sand or gravel on the finished surface to protect it until the excess clay has worked to the surface and washed off.

Just as much care is taken in finishing a gravel road as one costing three times as much, in trimming up the shoulders properly and cleaning out the ditches so the water can get entirely away from the road immediately after each rain. The last \$50 spent in an intelligent manner for shaping and trimming up any mile of road stands out more plainly than does any \$100 spent on the same road.

DO MAINTENANCE EARLY

The maintenance of Wisconsin pit-run gravel roads consists chiefly in the application of new material where necessary, shaping up the surface with a road plane or light grader, the removal of stone that may appear on the surface, and cleaning out the ditches and culverts. This work is done as early in the season as possible, one of the counties having shaped up over 50 miles during the month of April, 1916, by the use of a motor truck pulling two road planes covering a width of 18 ft. An average of 10 miles per day, including the removal of loose stone from the surface, was completed at a cost of less than \$5 per mile. When new material is added the road plane is used to even up the surface before it becomes thoroughly compacted. A cheap light oil is often used to advantage in the maintenance of this type of gravel road, but heavier oils are not advocated for the reason that the wearing surface is liable to be somewhat uneven in quality, the soft or loose spots invariably pitting out, which is anything but satisfactory.

The maintenance of the crushed-gravel roads consists in placing new material where necessary each year, a surface treatment with a good asphaltic oil or refined tar, and cleaning out all ditches and culverts.

WINTER HAULAGE REDUCES COST

It is customary when the crushing machinery is located in a gravel pit to crush an additional amount of material to be used for future maintenance. Some counties haul this material during the winter months, which generally reduces the cost to a considerable extent. It is deposited in large piles near the roadside and used as needed. The surface treatment is applied in the same manner as on a stone macadam surface. The surface is swept perfectly clean with a power sweeper, followed by hand brooms, to insure the removal of all vegetable matter and dust pockets. About 0.6 gal. of bituminous material per square yard is applied with a pressure distributor. A covering of about $\frac{1}{4}$ in. of fine gravel or torpedo sand with the bitumen forms a carpet that protects the wearing surface.

A system of patrol maintenance should follow this surface treatment, as spots are likely to appear that require an additional amount of bitumen, which if not taken care of immediately will cause holes to appear in the road surface that will be very disagreeable.

Deep Girders for Tank on New Top Floor of Chicago Building

Union League Club's Three-Story Addition Provides Gymnasium and Swimming Pool—New Columns on Special Foundations

CARRYING a swimming tank at the new eleventh-floor level and providing a gymnasium with locker rooms and other facilities, the steel framework added above the original old eight-story building of the Union League Club in Chicago contains plate girders nearly 11 ft. deep lined with cement, sheet lead, waterproofing and tile to form the walls of the tank. Other special features are the foundations, which had to be designed to avoid interference with existing column piers and carried down more than 60 ft. to rock, and the cantilever truss framing with eccentric connections to columns. The following data are taken from an address presented to the Western Society of Engineers by F. E. Brown, structural designer for Holabird & Roche, architects, of Chicago, who designed the additions and alterations.

SWIMMING TANK ON ELEVENTH FLOOR

As a large space unobstructed by columns was necessary, it was impracticable to locate the swimming tank in the present basement, and therefore three stories were added to the old building to provide the desired swimming pool and gymnasium. This old original building covers 49 ft. of the south end, or rear, of the lot, and is of skeleton construction, with steel beams and girders and cast-iron columns eight stories in height. The framing for the upper of the three new stories, or the eleventh floor, is indicated in one of the drawings, and the photograph shows the roof framing and deep plate girders which act as sides of the swimming tank.

The tank is 30 x 60 ft. in plan, and provides for a water depth of 8 ft. 6 in. at the plunge and 4 ft. at the shallow end. Directly over and covering the entire area of the swimming pool is a double skylight, the top lights on a straight pitch and the inner lights of amber glass in the form of an arch. The bottom of the tank occupies a large part of the tenth floor, while the remaining space on that floor is used for locker and dressing rooms.

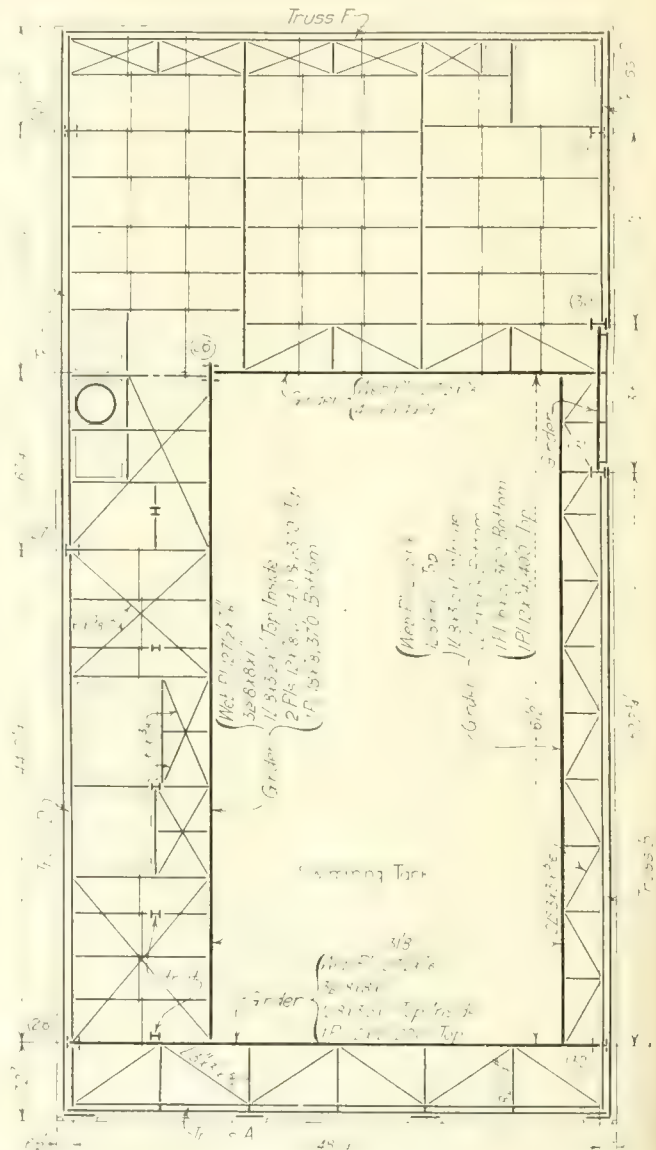
OLD COLUMNS REINFORCED—NEW FRAMEWORK

The old cast-iron columns were good for little added loading and could not be reinforced to any great extent. Furthermore, the old foundations were inadequate and could not readily be reinforced, hence replacing old columns by new steel columns was out of the question for the heavy loads of the tank floor. The old columns below the seventh floor and foundations were, however, strong enough to support the new ninth floor, as the original design was made for nine stories, six stories built permanently and the seventh as a temporary story with light columns. These light seventh-story columns had to be reinforced by filling and inclosing them with concrete, reinforced with hoops and vertical rods.

The new tenth and eleventh floors are supported independently of the old columns on eight new columns, as indicated, located to clear the old foundations and not obstruct important rooms in the old building. In only one case could a column be located at a corner of the tank or in the interior of the building, and none could

be placed in the end walls. Since seven of the new columns were located in the walls, some especially difficult cutting and reframing of old spandrels was required. In the east and west direction the old spandrel and wall beams served as braces for the new columns, but in the north and south direction new beams were added, consisting, in general, of 12-in. channels laid flat and bolted to the top flanges of the old floorbeams.

The sides of the swimming tank are plate girders nearly 11 ft. deep, with record-breaking plates 127½



FRAMING PLAN OF ELEVENTH FLOOR—LOCATION OF COLUMNS

in. wide. These girders support parts of the tenth and eleventh floors and roof and the 800,000 lb. of water. The sloping bottom of the tank is made of 18-in. I-beams spaced 13 to 24 in. apart on centers, with ¾-in. plates riveted to the top flanges of these beams and to shelf angles on the main girders.

In the tenth story on all four sides of the building a system of trusses is used to support the walls and the floors above, and also the east and west walls of the ninth story and the adjacent ninth-floor area. As shown on the plan, some of these trusses cantilever over the new columns located 7 ft. and 10 ft. from the building lines. Truss C has such a short anchor arm that the

cantilever load causes uplift on column 30, advantage of which was taken in the design of the column. Secondary stresses were investigated and found so high in combination with direct stresses in truss C that side plates were added in several members.

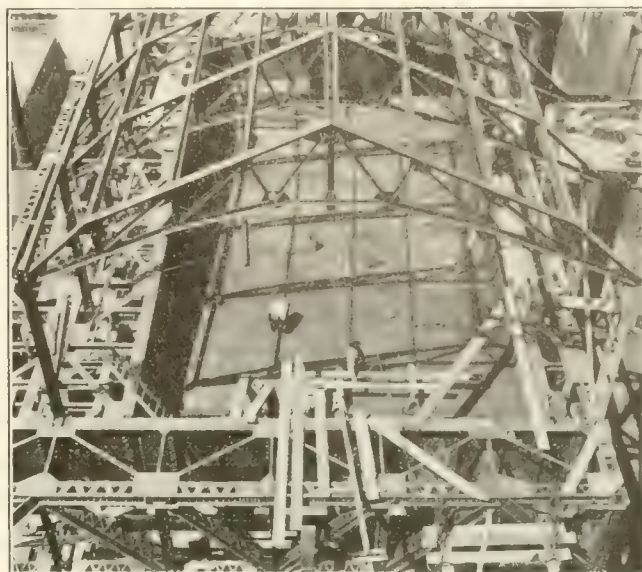
Lateral bracing, as indicated in the plan, is used at the tenth and eleventh floors between the wall trusses and the tank girders. This resists the lateral pressure of the water on these top flanges of the girders, which are made of unsymmetrical section, with the longer flange on the outside of the tank.

LINING OF TANK

After much discussion, and after the objection of the contractor to the original specifications calling for membrane waterproofing, concrete and tile in conjunction with calking and welding to make the steel watertight, a lead lining was substituted. The rivet heads on the inside of the girders were flattened to $\frac{1}{2}$ in. and $1\frac{1}{2}$ in. of cement put on with a cement gun. Next to this, sheet lead weighing 4 lb. per square foot, or about $\frac{1}{16}$ in. thick, was placed, and fastened by tacking to wood strips set in the cement. The joints were soldered to make them watertight. Membrane waterproofing was placed next to the lead, 4 in. of cement put on with the cement gun and the lining faced with ceramic tile $\frac{1}{4}$ in. thick set in cement mortar.

The bottom of the tank was lined in the same way, except that less cement was used. The total thickness of the lining is 7 in. for the sides and 4 in. for the bottom. The outside of the girders were fireproofed with tile and plastered where they form the walls of rooms in the tenth story.

Seven new concrete piers were constructed to carry



ROOF AND FRAMING OF SWIMMING TANK ON THE TOP FLOOR

the eight new columns. Columns 30 and 31 could not be placed on separate piers on account of interference with old piers, and were supported by balancing them over one pier, as shown in a drawing. The new piers vary in diameter from 4 ft. 4 in. to 6 ft., and extend to hardpan, being belled out to a diameter two and one-eighth times the diameter of the shaft.

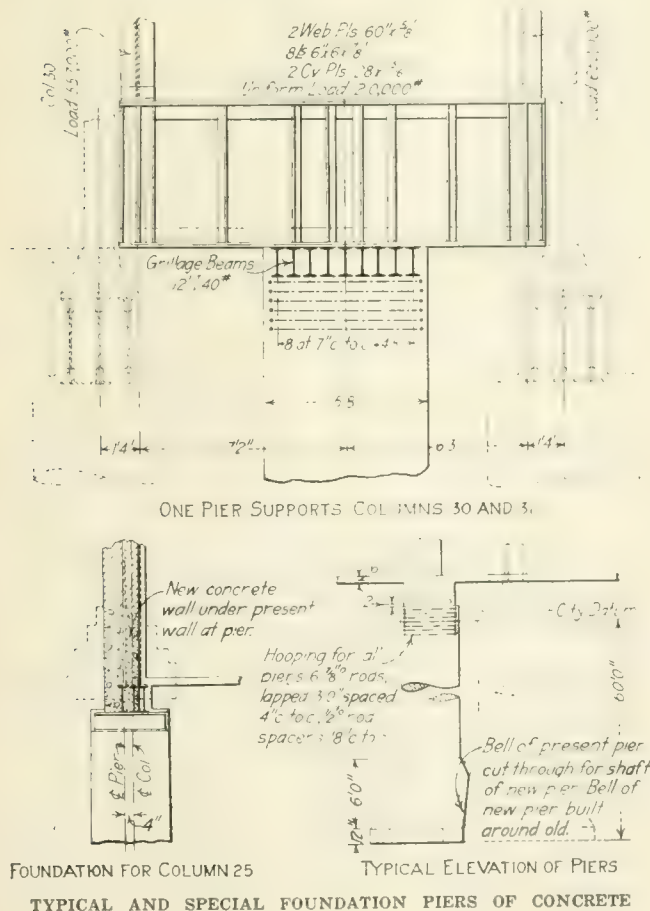
SINKING CAISSONS

In sinking the caissons, the danger of settlement of the adjacent soil and of the old columns was avoided by applying an initial pressure to the firm clay soil as the caissons were sunk. This compression was exerted horizontally by using two sets of diaphragms and four jacks to each set of lagging.

All of the steelwork was erected by one derrick set up on the old eighth floor, the new columns in one and two-story lengths being lowered through the openings cut in the floors. The heavy trusses and girders were erected in 20-ft. lengths, requiring special shoring and bracing to hold them in place until the splices were made. After placing the new steel framework, the construction was carried through to completion in the usual manner.

Excavating at 3½ Cents Per Cubic Yard

The "Yuba Sixteen," a gold dredge recently launched in the Sacramento Valley, California, is the latest addition to a fleet of dredges in that district, which is said to hold the record for quantity and economy. The new dredge is designed to bring up gravel from a depth of 80 ft. below water level, separate the recoverable gold, and deliver the waste over a bank 20 ft. high, thus lifting the material a total distance of 100 ft. The average cost of handling this material, allowing for a normal amount of trouble with boulders and buried trees, is 3½ cents per cubic yard. The dredge is expected to move 4-ton boulders and under normal working conditions to excavate 350 cu. yd. per month. All equipment is electrically operated, and most of it is automatic, so that a crew of three or four men is all that is required.



Earth Lining Prevents Seepage in Porous Shale

Reclamation Engineers Give Results of Season's Operation on the 37-Mile Grand Valley Canal in Colorado

THROUGH porous shale sections seepage from the Main Canal in the Grand Valley Project of the U. S. Reclamation Service was materially reduced by earth lining or artificial silting. J. H. Miner, project manager, describes the method and results in the December *Reclamation Record*. The wetted perimeter of the length of the canal is largely in a gray shale in more or less advanced stages of disintegration. Generally it is finely broken up by nearly horizontal seams and vertical fissures. In this condition it is very porous. Excessive losses from the older canals in this region have resulted in waterlogging large areas below the canal. Frequently the accumulation of alkali was sufficient to prevent plant growth.

CONCRETE LINING NOT FEASIBLE

Lining with concrete was not considered feasible, since these shales swell when wetted so that concrete lining might be expected to become cracked and inefficient. The protective measures adopted consisted in excavating the canal through shale to a depth of 1 ft. below the required grade, with a view to allowing silt to accumulate in this extra depth. When cleaning may be necessary the silt in this section will not be disturbed. At some points where especially porous shale was encountered, the canal section was excavated with $\frac{1}{2}$:1 side slopes below the normal water level, but the top width of the wetted section was not changed. In this way a triangular section was formed on either side of and outside of the required water section. These triangular areas were later filled with good surface soil crowded off the top of the slope. Part of the earth lining was placed before water was turned into the canal, and part afterward. The work done with the water in the canal was the more effective in that the material compacted better and more quickly and also spread farther out on the canal bottom. Earth lining or artificial silting was necessary in one case, due to the fact that the Grand River carries very little silt.

"GOAT" ROLLER DOES COMPACTING

The local shales disintegrate very readily on exposure to air and moisture. Advantage was taken of this fact by plowing and harrowing the shale portions of the canal bottom in the fall of 1915 after water had been run in the canal. The upturned shale was left exposed to the elements through the winter, and in the spring was again stirred with a heavy harrow to assist nature further in the breaking-up process. The shale has a tendency to break up in flakes that do not compact readily. A so-called "goat" was devised to hasten the compacting. It resembles a land roller, or pulverizer, except that the faces of the rolls are provided with projections about 3 in. long, 2 in. in diameter at the tip, and spaced about 6 in. apart in each direction. The "goat" is hauled repeatedly over a given area and has the effect of trampling animals. It apparently made the canal bottom more compact, but

no data have been secured to show directly what its effect might be in reducing losses by percolation. This "goat" was delivered but a short time before water was turned into the canal in the spring of 1916, and consequently it was used on only a small part of the canal length.

EARTH LINING

Section 1 contains only a small part of shale, and the plowing and harrowing of this shale and the placing of the earth lining were completed in 1915. The "goat" was worked in a part of this section in the spring of 1916. Section 2 is perhaps 50 per cent in shale. This shale was plowed in the fall of 1915, and earth lining was placed in the late fall and early spring.

The section from Sta. 1375 to Sta. 1965, No. 3, contains a still greater per cent of shale. The shale was also plowed in the fall of 1915, but not harrowed, and the earth lining in this section was placed during the run of water in the season of 1916, that beyond Sta. 1850 being still uncompleted. Between Stas. 1100 and 1660 the canal was greatly benefited by silt brought in by a cloudburst on Aug. 13, which broke through the upper bank in a number of places. During the period from July 26 to Aug. 14, the Grand River water carried an unusually high percentage of silt, and as much of this water was taken into the canal as the conditions at the wasteways would permit.

LOSSES REDUCED RAPIDLY

The tabulation of conveyance losses shows the following results, all losses being given in cubic feet per square foot of wetted area for twenty-four hours:

On section 1, from Sta. 22 to Sta. 906, the loss during the period June 1 to 5 averaged 0.557; for the period from July 17 to 21 this had been reduced to 0.248, and for the period Aug. 27 to 31 to 0.201. In section 2, between Stas. 906 and 1375, the loss increased from 1.007 in June to 1.076 in July, and then decreased to 0.948 in the August period. In section 3 the loss increased from 1.94 in June to 2.118 in July and then decreased to 0.588 in August.

The increase in the July period for the second and third sections was probably due to the fact that a greater quantity of water was carried through those sections in July and the upper edges of the wetted area had not become compacted.

VARIATION OF LOSSES EXPLAINED

The variation in the amount of loss in the three sections is further explained as follows: In section 1 all work was completed before observations were begun, and the improvement was due solely to the deposition of river silt and other natural causes. In section 2 a very small amount of work was performed during the period covered by the observations, and very little effect was realized from the river silt. On account of being unable to waste water from the canal without damage to property, it was necessary to so limit the volume of flow through the canal that low velocities obtained, and hence practically all the silt was deposited in section 1. The large reduction in losses in section 3 was due to the large amount of work performed on this section during the period covered by the observations and to the silt deposited by the heavy inflow of surface water

during storms in the fore part of August. For the canal as a whole the losses during the June, July and August periods were, respectively, 1.013, 0.923 and 0.481 cu. ft. per square foot of wetted area for twenty-four hours.

SPECIAL TREATMENT GETS RESULTS

As an extreme illustration of the results obtained from earth lining and silting, observations were made in the vicinity of Sta. 1274 on the Main Canal, where the water prism is entirely in shale. The canal is carried by a flume over a wash at this point, and the bottom of the wash is about 12 ft. below the grade of the canal. Seepage appeared in this wash within twelve hours after water first reached this point in the canal, and continued to flow freely until the earth lining was placed and fine silt chuted into a temporary contraction of the channel above this section. During the silting operations a sack dam was maintained about $\frac{1}{2}$ mile down the canal to raise the water level 18 in. When the operations started the seepage flow down the wash measured by a Cippoletti weir was 2.45 sec.-ft. The placing of earth lining immediately reduced this to 1.96 sec.-ft. The artificial silting operations reduced the flow to 0.28 sec.-ft., or about 12 per cent of the original flow. No further work was done at this point, but the effect of further silting by storm water, two months' flow of river water, and settlement of the earth lining still further reduced the flow to 0.053 sec.-ft. In this instance the flow of free water was reduced 98 per cent.

LOCAL TREATMENT TO REDUCE LOSS

Observations on a 2-mile length of canal in shale on which no protective work had been done have shown an average loss of 4 cu. ft. per square foot of wetted area for twenty-four hours. The present observed loss of only 0.48 cu. ft. per square foot compares favorably with the losses observed by Don H. Bark in rather impervious clay soils in southern Idaho and with the conveyance losses accepted by Etcheverry for all material except impervious clay loam and medium clay loam underlaid with hardpan. By local treatment at points of greatest loss it is expected further to reduce this average rate for the first 37 miles. The remainder of the canal is located too far from the headgates to receive any of the silt taken in with the river water, and in order to eliminate conveyance losses in this lower portion of the canal, it is intended to install a silting plant, using pumps and a hydraulic giant to break up beds of suitable material and get it in suspension in the canal water.

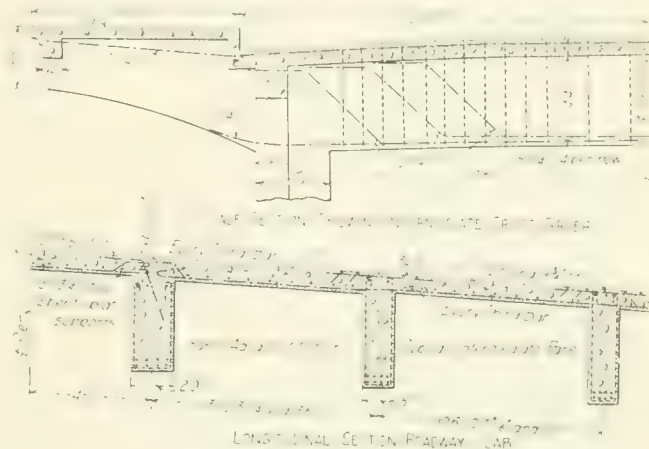
State Compensation Insurance Plan Works Well in California

A report on the State Compensation Insurance Fund in California announces that in the last fiscal year the income was \$1,837,761 and the net surplus over and above all liabilities was \$242,000. Dividends declared have amounted to 15 per cent of the premiums earned during 1914 and 1915. The actual refunds do not constitute the entire saving to patrons, it was pointed out, but represent a saving in operating cost only. The total average expense ratio is given as 14.47 per cent, or less than half that of insurance corporations.

Lead-Lined Expansion Joints in Floor of Concrete Arch Bridge

Five-Span Structure Designed for Seventy-First Street Crossing of Blue River in Swope Park, Kansas City, Mo.

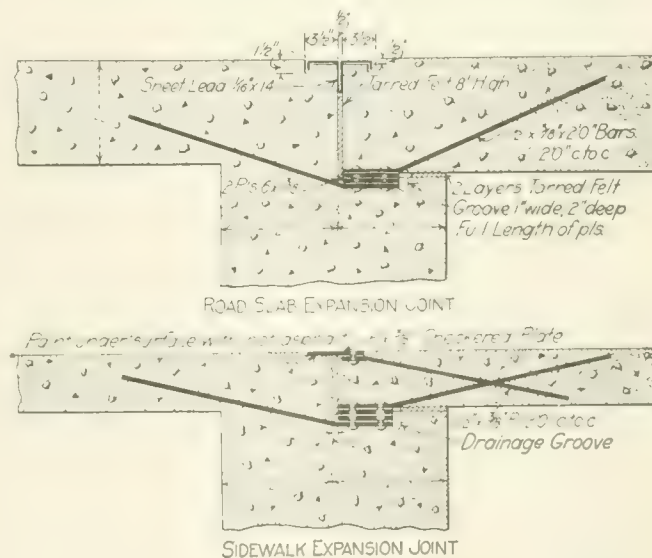
AMONG the design features of the five-span reinforced-concrete arch bridge for the Seventy-first Street crossing over the Blue River in Swope Park, Kansas City, Mo., are the details of the lead-lined expansion joints for the roadway slabs and the hooked ends for the reinforcing rods at these joints. The



TYPICAL REINFORCEMENT OF FLOOR SLABS AND CROSS-GIRDERS

drawing here reproduced indicates the nature of these details and of the typical slab-and-beam reinforcement for the arch floor.

The bridge is designed as a practically symmetrical structure, except for the 5 per cent grade descending toward the east, with a 120-ft. clear span in the center over the river. The total length of 700 ft. consists of this 120-ft. central arch span, two 100-ft. spans, one on each side, two 60-ft. spans, one at each end, the 20-ft. intermediate piers and the hollow-box abutment or retaining walls, each 80 ft. long. All arches are of the open-spandrel type, with curved spandrel beams, and two main ribs supporting the cantilever cross-beams



ROAD SLAB AND SIDEWALK EXPANSION-JOINT DETAILS

either directly or by the spandrel columns. The roadway is 40 ft. clear and the sidewalk 8 ft. clear on each side. No trolley tracks are provided for in the design.

DETAILS OF EXPANSION JOINTS

The expansion joints in roadway and sidewalk slabs are placed on each side of each pier, thus varying from about 130 to 70 ft. apart. The joint in the roadway slab, as shown in the drawing, consists essentially of two 6 x $\frac{3}{8}$ -in. plates designed to slide on each other, the contact surfaces being coated with axle grease, and held in place by the $1\frac{1}{2}$ x $\frac{3}{8}$ -in. bars 2 ft. long, riveted to the plates by countersunk rivets. The $\frac{1}{2}$ -in. joint is filled with tarred felt and protected by sheet lead bent in to the joint and covered by hot asphalt up to the level of the top of the roadway slab, which is to be paved with 4-in. creosoted-wood block.

For the sidewalk slab a similar joint is designed, except that a checkered plate is used instead of the bent lead plate and asphalt filler. Outside of the steel bearing plates the horizontal joints are to be filled with two layers of tarred roofing felt separated by a layer of plain roofing paper saturated with paraffine oil.

REINFORCEMENT DETAILS

Among the details of the reinforcement, which are indicated in the drawing, attention is called to the hooked ends of rods at the expansion joints and the $\frac{3}{8}$ -in. spacer rods in the top flange of the cross-girders.

The design of this bridge was made by Waddell & Son, of Kansas City, Mo. The contract was awarded to the Horton Concrete Construction Company, of the same place, on Nov. 22 for a little less than \$145,000. Construction has begun under the supervision of the designers as consulting engineers for the Board of Park Commissioners of Kansas City.

Hawaiian Tunnel Driven by Japanese Labor Working Waist Deep in Water

C. H. Kluegel Describes Difficulties Caused by Heavy Inflows Which Were Used Ultimately as Source of Power for Construction

WORKING waist deep in a torrent of cold water caused by an inflow of as much as 35,000,000 gal. daily, Japanese drillers and muckers, in 6-hour shifts, drove the 7 x 7-ft. main tunnel of the Waiahole Water Company's new supply system for irrigating sugar land in Hawaii against discouraging odds. To cope with the water which poured into the bore as the north heading advanced, the floor was first lowered in order to facilitate drainage by gravity. Then two siphon pipes were installed, but failed to give the desired relief. Finally it became necessary to drive a relief or drainage tunnel parallel to the main tunnel and at a slightly higher level in order to intercept and carry off a portion of the troublesome inflowing water. This cut down the flow to a point where it was possible to advance the north heading about 12 ft. a day and the tunnel was holed through Dec. 13, 1915. A unique feature of the project was the use of the inflowing water from the tunnel heading as a source of power for operating the construction plant. A 350-hp. Pelton waterwheel was installed in a gulch near the north portal and operated

under a head of 250 ft. A description of the general plan of the new water supply system and of the difficulties encountered in its construction was given recently in a paper before the Hawaiian Engineering Society by Charles H. Kluegel, under whose direction the work was completed. From this paper the following extracts have been taken.

GENERAL PLAN

The general plan provided for collecting the water from the many streams and gulches on the windward side of the Island of Oahu by means of tunnels through the ridges or spurs, and conveying it through the mountain in the main tunnel to the leeward side of the island, thence by tunnels, ditches and pipes to the upper levels of the Oahu sugar plantation. The tunnels connect the various streams on the north side and take in the water at the adits in the gulches. There are twenty-seven of these tunnels on the north side, varying in length from 280 to 2332 ft. The aggregate length of the north side tunnels is 24,621 ft., or 4.66 miles, being in reality one continuous tunnel. The number of adits at which water is taken in is thirty, the intakes being located at the most advantageous points at the streams in the gulches.

The length of the tunnels on the south side is 19,211 ft., or 3 $\frac{5}{8}$ miles, this distance comprising 14 tunnels, varying in length from 346 to 3329 ft.

The length of open ditch between the last tunnel and the Waikakalaua gulch is 20,000 ft., or 3.79 miles. This portion of the waterway crosses three gulches, where riveted steel pipes are used, ditches being impracticable. The aggregate length of steel pipes is 4460 ft., and the diameters vary from 72 to 78 in.

SUBDIVISION OF WORK

For convenience of administration, the project was subdivided as follows:

	Ft.	Miles
North division tunnels	24,621	4.66
Main tunnel	14,567	2.76
South division tunnels	19,211	3.64
South division ditch	20,000	3.79
Pipes	7,290	1.38
Honouliuli ditch	12,650	2.40
Honouliuli ditch		approx. 2
Distributaries		approx. 6
Total		26.53

At the beginning of the tunnel work, three shifts of 8 hours each were kept going. This was continued until the large amount of water coming into the tunnel, at the north heading, became troublesome. On account of the hardship to the men, working for 8 hours in the cold water, it became necessary to cut the shifts down to 6 hours each, so that four shifts per day were employed for this heading. The temperature of the water in the tunnel was approximately 66 deg. Fahr., or about 8 deg. colder than the artesian water in Honolulu.

The main bore had proceeded only about 200 ft. from the north portal when water to the extent of 2,000,000 gal. daily was developed on breaking through the first dike. These dikes are hard, impervious strata of rock lying approximately at an angle of 45 deg. to the tunnel axis, and nearly vertical, and they occur at intervals of varying length. Between the dikes was the porous water-bearing rock, thoroughly saturated, and with the water often under considerable pressure. When a dike

was penetrated, the water would spout out from the drill holes and would gush from the openings blasted in the headings. As the work progressed, the water increased in quantity, and the difficulty of the work was enormously greater on account of the water.

The slope of the tunnel being downward from the north portal, the matter of getting rid of the water by drainage was also one of great difficulty. This at first was managed by lowering the floor at the north portal about 2 ft., this being thought sufficient at that time, and allowing the water to drain out by gravity.

WORKING WAIST DEEP

At about 900 ft. from the north portal, the flow of water having increased to 26,000,000 gal. daily, the floor was again lowered to 5 ft. below grade at the portal, and at this stage the men in the heading were working waist deep in cold water, in a perfect torrent, the inflowing water coming principally from the face and from the roof and sides for a distance back from the heading, the flow of water apparently following the heading fairly closely. The pressure of water in the drill holes interfered very much with the blasting, so that the ordinary methods of charging and firing could not be used. The final expedient resorted to to hold the dynamite in place until it could be fired was to pack the sticks of explosive in thin metal tubes of the diameter of a stick of powder, and of sufficient length to inclose the quantity of powder desired. This scheme gave good results, but was expensive and materially delayed progress.

The texture and hardness of the rock varied considerably—some of it being particularly soft and porous and much of it hard and flinty, particularly at the dikes. The dikes varied in thickness from 14 ft. down to about 4 ft., but all the dikes were composed of very hard, close-grained rock which was apparently waterproof. The rock, however, was gritty and abrasive lava, and necessitated an unusual amount of drill sharpening, two of the latest type drill-sharpening machines being kept busy all the time.

DRAINAGE TUNNEL DRIVEN

When the water had increased to the point where it could not be drained out by gravity by lowering the floor at the north portal, a siphon pipe made of redwood, 16 in. in diameter, was installed, and this made it possible to drive the work ahead a short distance farther. A second siphon pipe 20 in. in diameter was next installed at the side of the tunnel immediately over the top of the 16-in. siphon, and this gave further relief and made it possible to extend the north heading to approximately 1400 ft. At this point the maximum inflow of water was approximately 35,000,000 gal. daily, which was taken out by the two siphons and gravity drainage.

It was seen that the siphon method alone would not suffice for further drilling, so a relief or drainage tunnel was driven on the west side of and parallel to the main tunnel at a slightly higher level and on an ascending slope from the portal, its object being to intercept and drain off a portion of the troublesome inflowing water. This expedient proved helpful after the tunnel was extended in about 1400 ft. The two tunnels were then worked alternately, the floor of the main tunnel being kept above grade to avoid having the tunnel men

work so deep in the water. They were working at this time in water about 3 ft. deep.

RELIEF TUNNEL ACTS AS DRAIN

This alternate working was continued to 1700 ft. from the north portal, where a chamber was blasted out of the solid rock on the side next to the relief tunnel. A cross-cut was made to connect the two, and a centrifugal pump of 13,000,000 gal. capacity was installed, which raised the water of the main tunnel through a pipe to the relief tunnel, which at this point is about 18 ft. higher. The relief tunnel acted as a drain.

With this arrangement, the work proceeded until the two headings met on Dec. 13, 1915, and although the trouble and difficulty with the water never entirely ceased, it was possible to proceed slowly at an average rate of about 12 ft. per day of 24 hours with three shifts.

SOUTH HEADING PROGRESS RAPID

From the south portal the progress was rapid, often as high at 630 ft. per month, or about 21 ft. per day on an average, notwithstanding the long haul, which at the last was over 2 miles.

The first dike on the south side was struck at 10,518 ft. from the portal, the first evidence of water being from the drill holes, from which the water spouted under pressure. The measurements of pressure by gage on some of the plugged drill holes showed a pressure of 65 lb. per square inch, corresponding to a static head of 150 ft. When water was struck, the excavation was discontinued temporarily. The spouting drill holes were plugged, the track was removed, and the floor of the tunnel, which up to this point was mainly through porous rock, was lined with concrete with a plastered cement surface. The walls in the meantime were lined and cemented to make them watertight. Such portions of the tunnel as required overhead arching had been arched and made ready for use.

The track was then replaced and the work continued at reduced speed, due to the water, which came in in large quantities, the maximum flow from this heading reaching 17,000,000 gal. daily, until the two headings met at 11,679 ft. from the south portal.

WATER AFFECTS PROGRESS OF DRIVING

From the foregoing it will be seen that 80 per cent. of the length of the main tunnel was driven from the south portal, and 20 per cent of the length was driven from the north portal, the difference in these proportions from the two headings being due to the presence of water at a much earlier stage in the north heading. Had there been no water to contend with, the length driven from each heading would have been approximately the same.

In order to give room for the water to flow from the heading, the track was raised on 4 x 12-in. timbers placed edgewise as stringers, on top of which the track ties were laid. The track was 24-in. gage, laid with 16-lb. and 20-lb. T-rail. The cars used were the standard Koppel 1-yard, all-steel dump cars. Electric locomotives driven by storage batteries were used in both headings. These gave good service on short hauls, except for the necessity of frequent recharging of the batteries, and minor difficulties due to water.

A gasoline-motor tractor was used for the long haul, until the track was raised in the south heading, the raising of the track leaving insufficient clearance for the gasoline locomotive.

CABLE HAUL INSTALLED

A cable haul was then installed, this operating without interruption from the water and clearance. The steel cable used was $\frac{1}{2}$ in. in diameter, and was approximately 4 miles in length, spliced to make a continuous cable, and running over a sheave secured to a timber in the floor of the tunnel at 10,800 ft. from the south portal. The cable tractor was a double-drum puller with a cable tightener, and was driven by belt and gearing from a 50-hp. electric motor. There was considerable wear on the cable, due to abrasion on the ties. This wear was much reduced by damming up the water in the tunnel at frequent intervals in order to permit the cable to run in the water, which apparently acted as a lubricant and reduced the wear. The cable parted on two occasions, and delayed the work until a splice could be made. One cable was completely worn out and the second cable used was probably about half worn out, over a period of eight months.

POWER PLANT USES TUNNEL WATER

The plant which actually supplied the power for use at the tunnel was a 350-hp. Pelton waterwheel belted to a 300 kw. three-phase generator, these units being installed in the gulch below and near the north portal. There was an abundance of water from the north heading, and the head at the Pelton wheel was 250 ft. This made an inexpensive and easily operated plant which was entirely satisfactory except at rare intervals when the water was low. The power was transmitted by pole line to the south portal in the opposite direction to that originally planned. For emergency use a steam power plant was equipped.

The local plant at each portal contained a duplex two-stage Ingersoll-Rand air compressor, supplying 800 cu. ft. of free air per minute at a pressure of 100 lb. per square inch, belted to electric motors; receivers, Leyner drills, sharpening machine, pumps, blacksmithing equipment, blowers for ventilation, a number of small machine tools for repair work, and facilities for making up the metal powder tubes. The air drills used were the water Leyner drills up to 10 ft. long. These drills use a jet of water under pressure which forces out the cuttings from the point of the drill. They are capable of rapid drilling, there being very little interruption from the clogging up of cuttings.

FOUR-INCH LINE SUPPLIES AIR

Air was supplied to the drills by a 4-in. pipe line running to a manifold which was always near the heading. Each round required from 12 to 20 holes, 8 to 10 ft. in depth, the holes being drilled at slightly converging angles in order to break the rock effectively. Each round required from 50 to 100 lb. of 40 or 60 per cent dynamite, Giant brand being used.

The ventilation of the tunnel headings was secured by forcing air by means of blowers through 16-in. metal pipes which were carried along the side of the tunnel, the air being forced in continuously. When a shot was fired, the direction of the blower was reversed for a

while, and the smoke and foul air were drawn out of the tunnel through the pipe until it was clear and fit for the men to work. This arrangement of ventilation proved effective and saved a great deal of time.

JAPANESE LABOR EFFICIENT

Special tribute should be paid to the Japanese tunnel men, without whom the excellent progress made on the tunnel would have been impossible. These "professional" tunnel men, as they call themselves, prefer this work to any other, and they apparently take delight in the hardships incident to the work, the exposure to the cold water, and the risk in handling explosives. They were on the job all the time and never failed to "deliver the goods" in situations in which white men or native Hawaiians would have been physically impossible. Most of the drilling and mucking was done by these tunnel men as subcontractors—a bonus being given for rapid work, which never failed to give results.

The general plan of development was recommended by J. B. Lippincott, consulting engineer, assisted by W. A. Wall. J. Jorgensen also had made a study of the project. H. K. Bishop was chief engineer when construction began in February, 1913, and was succeeded, after his resignation, by C. H. Kluegel. J. M. Young served as consulting engineer, and H. Olstad was superintendent in charge of operating the completed system.

Autos Outstrip Railways in Bulk of Passenger-Mileage

Value of Motor Passenger Service Exceeds That of Railways by \$200,000,000 Annually—Figures Given for Motor Trucks

By H. W. PERRY

Secretary, Commercial Vehicle and Good Roads Committee,
National Automobile Chamber of Commerce

PASSENGER automobiles are to-day rendering a greater transportation service than the entire steam railroad system of the country and greater than that of all electric railways. This statement seems almost unbelievable, yet the facts appear to prove it.

There are now registered and in use in the United States more than 3,000,000 passenger automobiles, after deducting duplicate registrations. The average mileage traveled by an automobile, based on conservative estimates, is 5000 a year. This gives a total annual mileage for all cars of 15,000,000,000. Assuming that the average number of passengers per car is three, the total passenger-miles per year is 45,000,000,000. On the basis of 2 cents per mile, the approximate average railroad fare, this service is worth \$900,000,000.

VALUE OF PASSENGER SERVICE

For comparison with these figures we have the latest report of the Bureau of Railway Economics showing that in 1914 the railroads carried 1,053,000,000 passengers an average distance of 33.6 miles, or 35,258,500,000 passenger-miles. The average fare was slightly less than 2 cents per mile, producing a revenue of \$700,400,000. Therefore automobiles render a passenger service worth nearly \$200,000,000 a year more than that of the railroads.

The latest street-railway figures at hand are for the year 1912, but as there has not been any marked extension of electric-railway systems and service in the last four years, and many such roads have reported heavy decreases in passengers and receipts during the last two years, the report for 1912 provides a fairly accurate basis for comparison. In that year these roads carried in excess of 9,500,000,000 passengers an average distance of 4 miles, or 38,000,000,000 passenger-miles. The total revenue from this service was slightly more than \$500,000,000, averaging 1 1/3 cents per mile per passenger. At this rate of fare the automobile gave service worth \$598,500,000, or \$98,500,000 more than the street and electric roads.

FIGURES FOR COMMERCIAL VEHICLES

Use of commercial motor vehicles has not yet reached a stage of development comparable with the passenger cars, yet the service they are giving mounts into large figures also. There are estimated to be 250,000 commercial motor vehicles in use. They average 50 miles a day, or 15,000 miles in a year of 300 working days, making the yearly total mileage 3,750,000,000. At least half this mileage is traveled with load. Assuming that the average load is 2 tons, the commercial motor vehicles of the country perform a service of 3,750,000,000 ton-miles.

By comparison, the steam railroads in 1914 gave 288,320,000,000 ton-miles, and earned a freight revenue of \$2,114,700,000, or a little more than 7 mills per ton-mile. At this rate the motor-truck service was worth only \$26,250,000.

MOTOR TRUCKS DO NOT COMPETE WITH RAILROADS

Motor trucks do not compete with the railroads in freight haulage, however, but take the place of, or supplement, horse-drawn vehicles. From an exhaustive investigation of haulage costs made by the U. S. Department of Agriculture the average cost of hauling to market is about 24 cents per ton-mile. Other investigations of city haulage show that the average cost of haulage by horse is about 17 3/4 cents. Taking 20 cents as a fair average value of haulage by highway, the motor-truck service is worth \$750,000,000 a year.

An official verification of the great service given by motor trucks and omnibuses is contained in the annual report of the New York State Highway Commission for 1915. A careful census of this traffic made in all the counties of the state, outside of cities and villages, showed that during a period of forty weeks (excluding the twelve winter weeks) these vehicles ran up a total of 14,734,680 miles and a ton-mileage of more than 60,000,000.

MOTOR TRAFFIC AND ROADS

The enormous value of passenger and freight service that is afforded by motor vehicles, aggregating a gross of \$1,650,000,000 a year, warrants the most conscientious study of how the public highways shall be improved to aid the development of this tremendous economic factor in the industrial, commercial, social and educational progress of the country. Shall the use of motor vehicles, particularly of trucks and buses, be restricted to meet the condition of the roads and bridges, or shall the roads and bridges be improved

much more rapidly than heretofore to sustain this traffic?

More than 82 per cent of all traffic on the 1100 miles of the state highway system in Massachusetts in 1915 was self-propelled. Wherever a similar census of traffic has been taken it shows a large predominance of motor vehicles using the roads. Obviously, the best interests of the country will be served by developing the main highways to meet the rapid progress that is being made in transportation by highway.

Flume Raised and Lowered Instead of Using Inverted Siphon

Concrete Counterweights Eliminate Heavy Lifting
—Flume Has Been Used Four Years—
Adapted to Long and Short Spans

By C. D. CONWAY

Superintendent and Engineer, Los Molinos (Cal.)
Land Company

THE "LIFT FLUME" shown in the photograph was designed and installed by the writer four years ago on the Los Molinos Land Company's irrigation system in Tehama County, California. The canal crosses the creek much lower than high-water level. As the grade is only 0.0007 per foot, it would have been necessary to



LIFT FLUME USED FOUR YEARS GIVES ENTIRE SATISFACTION

lose considerable head if an inverted siphon had been used. The company desired to maintain the grade in order to cover all the land possible.

A smooth No. 7 standard flume, having a capacity of 28 sec.-ft., was used in making the flume here illustrated. The lift portion consists of two 32-ft spans with six concrete counterweights as shown. After the water is turned off in the fall, the entire 64 ft. is raised simultaneously by two men, one at each end. No heavy lifting is required, as the flume and counterweights balance almost perfectly. A number of 50-lb. concrete blocks were made for additional weights, but it has never been necessary to use them. In the canal, a short distance from the lower end of the flume, a check-gate prevents the flood water from entering. During the last four years this flume has caused no trouble despite the fact that every winter the unraised portion has been submerged.

There are two other lift flumes on the project, one a 48-ft., the other a 32-ft. span. Both are constructed and operated as the one shown in the picture, except that they are single spans and therefore only four counterweights are necessary. They also have given entire satisfaction.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

"Standard" Pavement Specifications

SIR: My attention has been called to your news item and editorial reference to the convention of the American Society of Municipal Improvements recently held in Newark, and I beg space in your paper to briefly answer two points of rather personal reference.

Reference is made to opportunity given to a "manufacturer of a patented pavement—standardized by the society—to deliver not one but two addresses exploiting his product." There can be no doubt in the minds of anyone familiar with the subject that this is a direct, as it is an unjust, reference to the writer. The two addresses referred to were:

1. Motion pictures of the Columbia River Highway presented by the writer in his brief remarks of introduction, in which he very carefully refrained from making any reference whatever to the fact that Warrenite road surface, laid over the old macadam, is used on the 70 miles of Columbia River Highway and its approaches from the city of Portland, and confined his brief remarks strictly to the engineering problems solved and the scenic beauties and what prominent visitors have said about the highway. Among others, he read the following quotations of:

Gen. George W. Goethals, of Panama Canal fame: "The Columbia River Highway is a tremendous engineering accomplishment and it is the most wonderful scenic boulevard in America."

Ex-President William H. Taft, on visiting the Columbia River Highway in the summer of 1915, made a statement in an interview in the public press, strongly expressing the magnificence of the highway. (His exact statement is not before me at this writing.)

Ex-Governor Charles E. Hughes, following an automobile trip over the Columbia River Highway, Aug. 20, 1916, said: "It is the most wonderful highway I have ever ridden over."

Many thousands of visitors from all parts of the United States and Canada travel thousands of miles to see the Columbia River Highway. The average Sunday traffic is more than 4000 automobiles. Nearly every prominent magazine of the country has given illustrated articles about it. A comparatively few have had the opportunity of seeing about 150 natural-color pictures of the road.

During the past summer a motion-picture film was taken at the expense of the Portland chapter of the Shriners as its contribution to the program of the Shriners' National Conclave held at Buffalo in July. Learning that a loan of the motion-picture reel might be secured for the A. S. M. I. convention, I called the attention of the management to the opportunity, and was requested to secure its use and to present it to the convention. Being the second best way to see this wonderful engineering-scenic accomplishment, I thought I was proposing a real service to the convention, and

the large number of remarks made to me after the showing of the pictures indicated that it was regarded as a real treat.

2. The other of the "two addresses exploiting his product" is the writer's paper, regularly on the program, and written at the special request of both the chairman of the paving committee and the secretary of the society, on the subject, "The Passing and Conservation of Macadam City Streets and Country Roads."

Only twice in the paper was the word "Bitulithic" used, and then almost necessarily in connection with the reference to the typical instances referred to.

Now to the point which has been the subject of your several editorial references of the past year, to wit—the adoption at the Dayton (1915) convention of specifications for Bitulithic pavement.

Permit me to call your attention to the fact that the adoption was not made at the request, or even suggestion, of the writer, nor any other member of the company or organization he represents. On the contrary, the *Proceedings* of the Boston (1914) convention will show that the recommendation was first made by the chairman and the other members of the subcommittee, which at Dayton in 1915 most strenuously and in an improper "snap" proceeding endeavored to defeat its accomplishment, and by a more unparliamentary, improper and "snap" proceeding at Newark in 1916 endeavored to retract its adoption.

On the merits of the matter, permit me to ask a few important questions, to wit: What is a "standard pavement"? Is the proper adoption of specifications for all types of "standard pavements" limited to either patented or unpatented constructions? How long and under what varied general or extreme conditions must a pavement be used to become "standard"?

My view is that when, as is the case of Bitulithic, it has been in practical successful use for 15 years, adopted in over 400 cities, to the extent of over 43,000,000 sq. yd., under climatic conditions ranging from 45 deg. below zero in Edmonton, Alberta, to 140 deg. in Phoenix and Tucson, Ariz., and El Paso, Tex., that it is not only a "standard pavement," but that any committee or organization in adopting specifications for all types of "standard pavement" would be very derelict in its duty if it did not include this "standard" merely because it happens to be patented.

I further contend that it would be still worse to lead the public into unwitting infringement by adopting specifications for a standard construction—pavement or otherwise—which is in fact patented without so labeling it or by endeavoring to adopt something not standard because not sufficiently used to give it the dignity, but supposed to evade a meritorious patent, and which may not even accomplish that, but in the effort to evade, certainly would provide an inferior result.

Understand, I am not arguing for or against the adoption of specifications for any *one* pavement, pat-

ented or otherwise. In fact, I think "standard" specifications should include every form of construction which has had a long or broad enough practical use to prove its efficiency and economy, whether the desideratum be from either the point of view of high grade and correspondingly higher cost, or from the point of view of lower cost and, although inferior, economically useful at the price.

My insistence, however, is that an article is no less "standard" and should be no more shunned in the adoption of "standard" specifications because the proper government departments have granted and adjudicated patents proving its novelty. If anyone will brush away prejudice and, on that basis, give any sane reason why Bitulithic is not a "standard pavement" and why, as such, it should not be included in any set of "standard pavement specifications" adopted by any society broadly covering the field, they will be offering something which I have not yet seen or heard expressed.

GEORGE C. WARREN.

[Mr. Warren says he did not mention Warrenite in his talk on the Columbia River Highway. A "cut-in" on the film, however, did say that Warrenite (or Bitulithic, we forget which) was used. With reference to the address on "Passing and Conservation of Macadam City Streets and Country Roads," in addition to the two mentions of Bitulithic referred to by Mr. Warren, the preprints of the paper contained five pictures, and beneath each was a description saying that Bitulithic was used. In other words, as printed, there were seven, not two, references to Bitulithic.

On the matter of standardizing a patented article, we consider it incompatible with the dignity and principles of a technical society to show commercial partisanship. If Bitulithic can have a specification, why not every other patented paving that has proved its worth? It is the very injection of commercial matters which has discredited the American Society of Municipal Improvements and made it the laughing stock of those who know of the disgraceful character of some of its convention sessions.—EDITOR.]

City Should Pay Royalty Fee on Patented Devices

SIR: For many years municipalities have protected themselves against patent claims by inserting in their contracts a clause specifying that the general contractor shall assume all liability for patents and shall relieve the city from liability and render harmless the officials, etc. It is doubtful whether such a paragraph would apply to a patent obligation where the city specified a patented article, as shown on the drawings, and the contractor simply constructed, in accordance with his contract, the patented appliance or method of construction.

If the city pays the fee direct either to the patent holder or to his representative, it secures thereby a direct receipt. It is the city's right to have and to hold the license to use a patented article or process which has been called for by the engineer and which has been constructed by the contractor in accordance with his contract.

The city cannot obtain this license except by payment of the fee, and if the fee is to be paid by the contractor

it is important that the contractor know in advance of preparing his estimate what the fee amounts to and to whom it shall be paid; and if these formalities on the part of the city are carried out the contractor should make the payment specified to the proper party, obtain the license, and surrender it to the city.

It seems, therefore, important, and quite to the city's interest, that specifications for the use of the Imhoff patented sewage tank should specify the amount of the royalty fee, the person to whom payment shall be made, and the surrendering of the license by the contractor to the city before final settlement is made with the contractor for the work.

S. FISCHER MILLER,

President, Pacific Flush Tank Company, American and Canadian Commercial Representatives of Dr. Karl Imhoff.

New York City.

What Are They Doing About It?

SIR: The report of Prof. Ira O. Baker on the Chicago pavement conditions (abstracted in the Engineering Record of Dec. 9, page 702) has for the time aroused discussion. The question is being asked, "What will the citizens of Chicago, the responsible officials and others, do about it?" The reply almost invariably has been in a pessimistic tone, "Nothing. After the daily press has given the usual sensational treatment to the report, it, like many other vexatious things, will promptly be forgotten."

Pressing the question a little farther, may we not properly ask whether the engineers, especially those who are taxpayers of Chicago, do not have a duty not merely to the community but more immediately to the profession and to themselves, to see to it that reports of this kind are not pigeonholed but form the basis for systematic and persistent activity toward better engineering results.

In and about Chicago are several more or less active associations of engineers. Each of these has been formed for the advancement of engineering knowledge and practice and the maintenance of high professional standards among its members. The youngest of these organizations, and for this reason the one which from its extreme youth should be the most active, is the Illinois Association of Members of the American Society of Civil Engineers. This association has been formed in order that members might be able to express their views collectively with regard to the management of the society and to engage in such other activities as may be deemed desirable. It includes the men who stand at the top of the profession and whose opinion on all affairs has great weight. They may properly feel, however, that their interests should extend only to the purely technical details and not to the application of these to problems of daily life.

There is also another new organization of over a thousand members, the American Association of Engineers, composed of the younger men, most of whom "still have their future yet before them." They, too, are endeavoring to raise the ethics of the profession and to assist their members in every practicable way.

Still older, and with a well-established place in the community, is the Western Society of Engineers, with

its large membership, also the Illinois Society of Engineers, many of whom live in Chicago. Other associations might be named, but it is sufficient to call attention to the fact that we have several well-organized representative bodies of engineers equipped for effective work. The question is therefore not whether there is any one to do the work, but "Is the undertaking of a kind which would justify or require action by one of any body of engineers?" Or perhaps to put it another way, are the engineers, as a whole, concerned in a case like this, where it has been shown by one of the oldest, best-known engineers of the state that certain indefensible conditions exist in engineering work?

No question can be raised as to Dr. Baker's ability and fairness. His well-known textbook, "Roads and Pavements," has been widely used throughout the country. His large experience and mature judgment entitle his opinions to respect. His recent report to the Committee on Finance of the City Council of Chicago, dated Nov. 20, 1916, shows that certain engineering work has been badly done. The result is only too evident. The public, not fully informed upon all details, naturally lays the blame upon the engineers.

The advancement of engineering knowledge and practice and the maintenance of a high professional standard are retarded every time the public's attention is called to poor work on the part of professional men. This is intensified if the professional men, individually and collectively, ignore the existence of poor work and simply pass it over; silence gives assent. To this extent they are undoing the very object for which their organizations are formed. We may well ask, under such conditions, "Would the doctors or lawyers acquiesce by their silence?" It is fairly safe to assume that if a lawyer or doctor of high standing found it necessary to condemn certain professional work the local associations would immediately take up the matter and see to it that, as far as lies within their power, these improper conditions should no longer continue. It is by such prompt and effective attention that other organizations of professional men now retain their high standing in the eyes of the community. They cannot afford to let it be understood that improper, or even dishonest, practices are quietly tolerated.

High standing in the community is attained only by eternal vigilance, which is the price of high ideals. If, as many assert, the engineering profession is not highly regarded by the public, is it not because the engineers, through their associations, have failed to safeguard their reputation and by their inactivity at crucial times have confirmed the belief in their timidity or unwillingness to take any risks of contamination in connection with everyday affairs?

In endeavoring to maintain a splendid isolation from commercialism or worldly affairs are the engineers not losing the very thing for which they should strive? In other words, in quietly ignoring the conditions which Dr. Baker's report has revealed, are not the engineers of Chicago permitting the profession to sink in the esteem of other citizens?

An illuminating example of what has been done elsewhere is afforded by the action of the Affiliated Engineering Societies of Minnesota, which, according to their bulletin of Dec. 10, 1916, appointed a committee to investigate certain alleged extravagances in connec-

tion with a highway bridge. The report shows that the work was let at an exorbitant figure, and that the extras make the total cost still more exorbitant. It was inferred that the work was poorly done, due to lack of business judgment in letting the contract and to the adoption of inefficient methods of work and absence of proper supervision. The report recommends that the State Highway Commission do not furnish plans for bridges unless provided with authority and sufficient funds to maintain adequate supervision over the letting of the contract, the construction, and the final acceptance of the work.

It is also interesting to note that the members of the committee making this report served as a committee of the Northwest Association of Members of the American Society of Civil Engineers. Can or will their Chicago brethren follow the precedent thus established?

F. H. NEWELL,
Professor of Civil Engineering, University of Illinois,
Urbana, Ill.

Financial Status of the Pacific Gas & Electric Company

SIR: My attention has just been called to an article which appeared in the Engineering Record under date of Nov. 11, 1916, page 588, being a reprint of a paper presented by Leonard Metcalf, Oct. 11, 1916, at a joint convention of the Illinois and Iowa sections of the American Waterworks Association. While I am not disposed to discuss in any way the general scope of the paper by Mr. Metcalf, I must take a positive exception to certain statements therein made which are not founded upon facts and which, coming from a man of his reputation, are certain to work injury to this company.

In the article you make a subheading "Corporations in Financial Straits." Mr. Metcalf follows with the following statement: "Similar experience has developed in the Far West in the State of California, where, from one cause or another, acts of the corporation on the one hand, and on the other hand of the commission, or other public representatives, a large number of public service corporations are at present in financial straits. Among these might be mentioned . . ." He then goes on to give the names of a number of corporations in this state, among which he includes the Pacific Gas & Electric Company.

I cannot conceive where Mr. Metcalf obtained his information regarding the financial status of this company. He certainly has not read our annual reports, nor has he taken cognizance of all financial reports of this company filed with the Railroad Commission of this state. This company certainly is not in financial straits. It is perfectly solvent, is paying its dividends, and, except for its funded debt, is entirely out of debt, and has a very substantial surplus on hand. Its financial standing for the twelve months ended July 31, 1916, is herewith inclosed, showing the income account and the balance sheet. [The full statement is not reproduced, but the condensed balance sheet, dated July 31, 1916, shows total assets of \$150,399,541, total liabilities of \$144,890,875, leaving an unappropriated surplus of \$5,508,666.]

I have always been impressed with the fairness of

your journal in dealing with corporation situations, and am manifestly surprised that you should have permitted an article making an absolutely incorrect statement space in your journal, and trust that you will give it correction in your next issue.

While discussing the paper of Mr. Metcalf only with reference to its mention of the Pacific Gas & Electric Company, I cannot forbear to repeat what I have often said—that the corporations of this state are satisfied with regulation, and that, so far as the other companies mentioned by Mr. Metcalf are concerned, regulation had nothing to do with their financial straits; rather has regulation by the commission been helpful in solving the difficulties which they found themselves under by their own acts prior to regulation being in force.

JOHN A. BRITTON,

Vice-President and General Manager, Pacific Gas & Electric Company.
San Francisco.

[A copy of Mr. Britton's letter was submitted to Mr. Metcalf, whose reply follows.]

SIR: Thank you for your courtesy in submitting to me for comment copy of letter received by you from John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company of San Francisco, containing strictures upon a reference made in an address upon "Some Observations Upon Public Regulation of Waterworks," delivered by me on Oct. 11, 1916, before a joint convention of the Illinois and Iowa sections of the American Waterworks Association.

I regret that in making allusion to specific cases I should not have spoken more explicitly and limited the scope of my observations, as it appears from Mr. Britton's letter that the intent of my comment has been misconstrued. I regret this because, of course, I should be loath to give any false impression, and I am very glad of the opportunity to state that the present condition of the Pacific Gas & Electric Company financially is, I believe, as Mr. Britton has represented it.

The use by me of the words "in financial straits" was unfortunate. It would have been wiser to have used some such expression as "a large number of the public service corporations have suffered financially in the past." What I particularly had in mind, and what I believe to be true, generally speaking, of corporation control in the past, is that the earnings permitted many corporations have been somewhat smaller than desirable from the point of view of the public interest; that is, they have been such as to tend to make the service rendered by the corporation follow the demand rather than to anticipate it, and as to make it difficult for the corporation to borrow money upon the lowest possible basis. According to my view, the public suffers, as well as the corporation, from an impaired or too seriously limited corporate credit.

Moreover, I think that Mr. Britton has failed to appreciate my reference to "other public representatives" as well as to the commissions. In making this reference I had in mind certain other boards which antedated the commissions but which had power of control. Such an example is to be found in the Board of Supervisors of the city of San Francisco, in the hands of which was lodged the determination of the water and other rates, and by which board rates have been established in the

past which have been found confiscatory by the higher courts.

Public utility regulation is not a novelty in principle. The commission is but an improved means of control. A distinct step forward has been taken by the change to the latter, though it is, of course, true that the principles governing such bodies are constantly undergoing modification as a result of legal decisions handed down by our higher courts in corporate problems.

As to Mr. Britton's comment that "I cannot forbear to repeat what I have often said—that the corporations of this state are satisfied with regulation, and that so far as the other companies mentioned by Mr. Metcalf are concerned regulation had nothing to do with their financial straits," there appears to be some difference of opinion, for other men interested in public utilities and their management hold views differing widely from those expressed by Mr. Britton.

The writer agrees with Mr. Britton, however, that the present commission has been helpful in solving the difficulties in which some of the corporations have found themselves.

LEONARD METCALF,
Consulting Engineer.

Water the Chief Factor in the Making of Good Concrete

SIR: Referring to the article on "Water the Chief Factor in the Making of Good Concrete," by Nathan C. Johnson, in your issue of Dec. 30, 1916, page 790.

What Mr. Johnson says in regard to the menace of "day's-work planes" and of littance is very true. This may be overcome by boring a few holes near the top of the forms and allowing the "cement cream" to run away, also by leaving keyways of sufficient depth and breadth to insure a good bond for the next day's work.

I quite agree with Mr. Johnson's remarks about a too wet mix. Over-wet concrete should never be dumped into a column form from the top and so allow the larger aggregate to collect at the bottom. If it is necessary to fill from considerable heights, the material may be lowered into place, and in the case of a column the wet plastic concrete may be allowed to slide into place on a plank of the same inside width as the column form.

HERBERT CANTWELL,
Beauharnois, Que. Paper Mill Engineer.

September Railroad Income 10 Per Cent More Than in Year Before

Gross operating revenues for September, 1916, on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were \$1,409 per mile, showing an increase of \$158, or 12.6 per cent, as compared with September, 1915. Operating expenses were \$881, an increase of \$107, or 13.8 per cent. Net operating revenue, therefore, was \$528—an increase of \$51 or 10.6 per cent, and operating income was \$468—an increase of \$43, or 10.0 per cent. The operating ratio was 62.5 per cent, as compared with 61.9 per cent in September, 1915. Considering the three main districts, the respective ratios for September, 1916, and September, 1915, were as follows: Eastern, 65.8 and 62.8; Southern, 65.7 and 66.8; Western, 58.1 and 59.5.

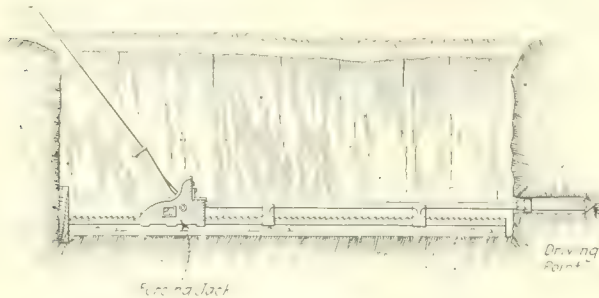
HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

CONTRIBUTIONS to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.

Pipe Up to Four-Inch Diameter Driven Under Pavements

USING the method shown in the drawing, a large Eastern electric service company has saved considerable trouble and expense in installing pipe conduits up to 4 in. diameter. The method, which avoids cutting through pavements and digging ditches which would obstruct traffic, consists in digging a pit at the side of the pavement on the bottom of which the jack may be laid



JACK DRIVES PIPE UP TO 4 INCHES IN DIAMETER UNDER PAVEMENT

in a horizontal position. The cage on the jack, the front of which is provided with a groove and clamp which can be adjusted to pipe ranging from $\frac{3}{4}$ in. to 4 in. diameter, is set at the far end of the rack. A short length of pipe is then inserted, to the front end of which is screwed, by means of an ordinary coupling, a steel nose. The jack is operated by a hand lever, forcing the pipe ahead into the ground. When the length of the rack has been traveled, the cage is carried back to the starting point and a new length of pipe inserted. The jack, similar in operation to an ordinary track jack, but with a much longer travel, is bolted to a plank when in use. It was furnished by the Duff Manufacturing Company. The method was described in a recent issue of the *Electrical World* by C. L. Dalrymple.

Suction Dredge Digs Pond for Itself in Gravel Pit

By R. M. CREAMER
Orangeburg, N. Y.

IN a gravel pit near Palermo, Cape May County, in southern New Jersey, where hand loading had previously been employed for excavating a few feet until ground water level was reached, a 6-in. suction dredge was recently installed which dug a hole for itself to float in and has since been used to load railway cars by discharging directly into them.

The pits in this part of New Jersey were formerly worked by hand at considerable expense. The larger part of the sand and gravel was left untouched by this method because ground water level was reached at shallow depths. The dredge at Palermo is mounted on a 12 x 30-ft. decked scow, and consists of a 6-in. centrifugal pump run by a belt from a 30-hp. gasoline engine. The hull was built and the machinery assembled in the pit. A hole was excavated by hand at the suction large enough to give sufficient water for priming the pump. The pump was then started and run until a basin large enough to float the dredge had been formed. The hull was then undermined and slid into the pond.

It is reported that this dredge, discharging run-of-the-pit material through a flexible-joint pipe line, can load a 50-ton gondola car in about 20 minutes. The water discharged overflows the sides of the car and runs back into the pit. When gravel alone is wanted, the dredge discharges on a stationary screen, the sand and water flowing through and the gravel sliding off into the car. The sand piles up around the screen, so that when sand alone is wanted it is only necessary to throw the suction of the dredge into the bank of the pond at this point and pump directly into the cars. The pit is on the edge of a salt marsh where the ground surface is about a foot above high tide.

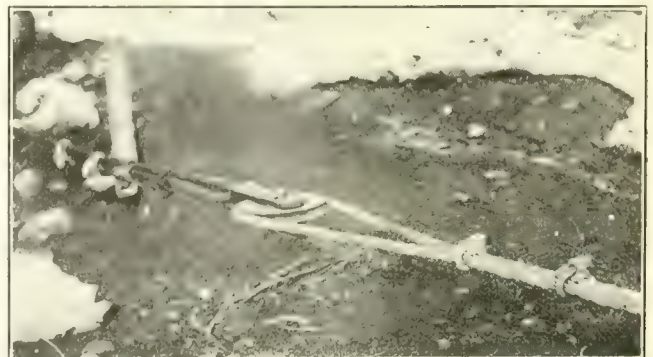
The 8 or 9-ft. depth of sand and gravel made available by this installation was evidently deposited following a considerable settlement of the coast, as at that depth a second layer of sod, containing roots and stumps, is encountered, overlying a further deposit of sand and gravel.

Proper Guy Anchorage Saves Cable

By R. E. POST

U. S. Reclamation Service, North Yakima, Wash.

IN the use of derrick or tower guys it is common experience that the least deterioration occurs while the guy is in actual service. Usually the guys are discarded because of kinks made by fastening them around small anchor devices. Perhaps the worst wear that



KINKED AND ROTTED GUY ENDS AVOIDED BY THIS RIGGING

comes to the guy in actual use is caused by the rotting of the core when the guy is fastened around a deadman and covered with dirt.

In order to avoid these causes for the short life of guys, and to make it possible to realize a reasonable percentage of their theoretical life, the rigging shown in the illustration was used with good success on the Keechelus Dam built by the U. S. Reclamation Service at Meadow Creek, Wash. While this anchorage rigging is not new, inferior ones are in such common use, according to the writer's experience, that the method is worth passing on.

The sheave and clevis are fastened to a piece of well-greased scrap cable of ample strength attached to the deadman, eyebolt or stump. When the derrick is moved, the kinks or rotted core, or both, will be in the piece of scrap and not in the guy.

This method of fastening makes it very easy to tighten a guy, for the sheave aids instead of retarding the process, as is the case with most fastenings. It promotes safety by keeping guys in first-class shape and eliminating the temptation to use guys after they become kinked. By using this anchor rigging, clevis attachments to the guy cap and galvanized rope with soldered ends, derrick guys can be made a quite permanent part of the equipment, as theoretically they should be.

Motor Truck Carries Own Loading Hopper from Job to Job

A PORTABLE gravel-producing plant which is carried from place to place by the motor truck which is used to load is in service on road construction work in Kane County, Ill. The portable crushing and screening plant for which the bin was built is run by power from a gasoline tractor. To avoid having the bin top-heavy, the screen is located at the foot of the elevator. The plant is supplied with gravel and boulders up to 10 in. size by teams and slip scrapers. It can produce more than 200 cu. yd. per day.

The bin, which holds 15 yd., was designed so that the trucks could drive under it. The posts on which it is supported are made in two sections, the lower ends of the posts and the sills being taken off and placed in the truck body for moving, while the upper portion of the structure is lowered to the truck. This construction can be plainly seen in the photographs, one of which



LEGS OF HOPPER COME OFF FOR MOVING

shows the bin en route on a White motor truck; the other shows the bin in use.

The plant was designed and used in building gravel roads under the direction of George N. Lamb, superintendent of highways, Kane County, Ill.

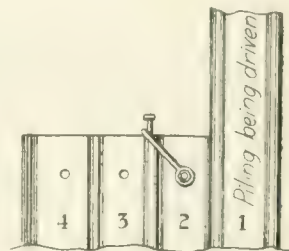
Shackle Prevents Sheet piling from Creeping Below Grade During Driving

By FRED C. TODD
Norwood, Ohio

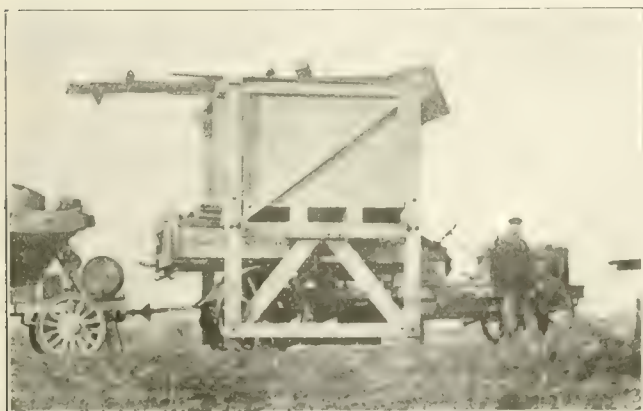
CONSIDERABLE difficulty encountered at Ohio River Dam 39 in holding steel sheet piling to the proper elevation during driving was overcome by securing each pile to the next with a long shackle, as shown in the sketch.

The piles were of the 14-in. arched-web type, 40 ft. in length. They are a permanent installation, driven on the upper edge of the navigable pass foundation, and extending 3 ft. into it. In the sketch, pile 1 represents that being driven, while piles 2, 3 and 4 have been previously driven.

During the driving of pile 1, pile 2 would creep below grade, due to the friction between the piling. In some cases the creeping of pile 2 would commence as soon as the driving was started on pile 1. If this had been allowed to continue until pile 1 was driven to grade, pile 2 would have been from 10 to 12 ft. below grade. The method used to prevent the creeping of the piling was to fasten a shackle to pile 2 with a 1 1/4-in. short bolt, lay the other end of the shackle over the top of pile 3, and insert a bolt in the joint between piles 2 and 3 to



SHACKLE STOPS CREEPING



TRUCK TRANSPORTS ITS OWN HOPPER

prevent the shackle from being pulled off. After the shackle was in place, pile 2 would continue to creep for about an inch until the shackle became tight. In one or two cases the friction developed in driving was so great that pile 2 would continue to creep, carrying with it pile 3. This necessitated an additional shackle between piles 3 and 4.

The shackle was about 15 in. long, made from 1-in. soft steel. The piles were driven with 3½ and 4-ton steam hammers. The work at Dam 39 is being done by government forces, with L. J. Prell, assistant engineer, in charge.

Face Gravel Pit South to Save Dynamite in Winter

IN IOWA some gravel pits are kept open during the winter, and the following instructions for their care are given in the *Service Bulletin* of the State Highway Department:

Cover the surface with a heavy coat of straw. This will keep out the frost and will save much dynamite. Open up the runway on an easy grade at the south side of the gravel pit, so that the sun will be on the sides and floor of the pit all day. In opening the pit, back down the runway and load so that the pit is circular. As soon as possible drive into the pit and make a circuit in coming out. Keep the bank caved down from the top, throwing out all black dirt and frozen chunks. Always load from the bottom and clean up as you go. Keep pushing back the straw as it is necessary to uncover for more material. Cave down the last thing at night and throw to the center all frozen chunks that cannot be used for road material. Be sure that the walls of the pit are entirely covered with loose material when left for the night or over Sunday.

Wire Rope Slings Best for Pulling Sheeting with Hammers

By A. B. LUEDER
Omaha, Neb.

WIRE ROPE, which cannot crystallize and break as does strap iron, has been used entirely in rigging an inverted hammer for pulling 35-ft. steel sheeting on work under the writer's charge at Omaha, Neb.

Robert Melvin, the first American to use a hammer in this way, found on the Lexington Avenue subway work in New York that the steel holding and pulling strap crystallized and broke, and substituted for it four parts of wire rope. On this work the idea has been carried further and the entire pulling rig made of wire rope. Sheet piles 35 ft. long which have been concreted in for 3 ft. at the lower end and completely backfilled have been removed by this equipment without changing the regular rigging on the derricks. Two parts of line are used in the derrick falls, with which a direct pull of not more than 8 tons can be made. From experiments carried out on the work it is evident that without the use of the hammer a direct pull of 75 to 100 tons would be required to start the piles. The hammer, however, pulls them without difficulty, the rate of starting being about the same as the rate of penetration in driving just before the piles reached the proper depth.

The wire rope rigging has been found on this work easier and quicker to change than straps, in addition to the advantage that the wire rope does not crystallize. The pulling is being done with a No. 6 McKiernan-Terry hammer, which was adjusted for the work on the advice of the makers by slightly changing the steam ports. This adjustment overcame a tendency for the hammer to break its top head.

The work on which this method is in use is being car-



WIRE ROPE SLINGS EASY TO RIG AND DO NOT CRYSTALLIZE

ried out for the Omaha Electric Light & Power Company by the Phoenix Construction Company. The work is under the direction of the Jarrett-Chambers Company, construction manager, with the writer as superintendent and B. I. Moran as general foreman.

Record-Breaking Year for Coke

The coke output of the United States in 1916 broke all records. More than 35,000,000 tons of beehive coke was manufactured—27 per cent more than in 1915 and 500,000 tons more than the record-breaking total in 1910. By-product coke amounted to 19,200,000 tons, which is 5,000,000 tons, or 36 per cent, more than the production in 1915. The total coke production, according to estimates prepared by C. E. Leshner of the U. S. Geological Survey, was 54,300,000 tons, an increase over 1915 of 12,700,000 tons, or 30 per cent, and over 1914 of 8,000,000 tons.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

George H. Pegram Made American Society President

Engineer Prominently Identified with New York City Railways Elected at Annual Meeting

George H. Pegram, chief engineer of the Manhattan Elevated Railroad, the Interborough Rapid Transit Company, the Rapid Transit Subway Construction Company and the New York Railways Company, was elected president of the American Society of Civil Engineers at the annual meeting in New York this week. Mr. Pegram's experience in the civil engineering field covers a period of 40 years, most of it in railroad work.

He was born Dec. 29, 1855, at Council Bluffs, Iowa, and was graduated from Washington University in 1877 at the head of his class. His first professional work was on the construction of the Utah & Northern Railroad, now part of the Oregon Short Line, in Idaho. In 1879 he was appointed chief assistant to Charles Shaler Smith, the noted bridge engineer. Two years after that appointment he was made chief engineer for the Edgemoor Iron Company of Wilmington, Del. Mr. Pegram visited Europe in 1886 and on his return to the United States established consulting engineering offices in New York City. The Missouri Pacific Railway retained him as its consulting engineer in 1889, and in 1893 he became chief engineer of the Union Pacific system. During the construction of the Pioneer Electric Power Company's plants at Ogden and Salt Lake City he was also consulting engineer to that corporation.

In 1898, when the construction of a subway in New York City first was being urged strongly and seemed likely to be undertaken, the Manhattan Railway Company decided to build a number of extensions. It was then that Mr. Pegram was offered the position of chief engineer. The extensions never developed, but the introduction of electricity as a motive power added to the engineering department's responsibility.

His appointment as chief engineer of the Interborough Rapid Transit Company and of the Rapid Transit Subway Construction Company came in 1905. Seven years later he was made chief engineer of the New York Railways Company. Among important works to be credited to him are the invention of the Pegram truss, the design of the Kansas City Elevated Railroad and that of the trainshed of the Union Terminal Station at St. Louis. He also directed the design and construction of the combined highway and railroad bridge over the Arkansas River at Fort Smith. This structure is believed to contain the longest Pegram truss ever built.

Human Side of Engineering Holds Attention at American Society Meeting

Debate Centers on Compensation and Conditions of Employment for Engineers and Opportunities for Broader Service—Concrete and Valuation Reports Received

Despite the readiness with which the annual meeting of the American Society of Civil Engineers on Jan. 17 swept aside the few rather feeble protests and accepted the report of its special committee on compensation as truly indicative of how the average engineer fares financially, the subject and correlated questions pertaining to engineering conditions and opportunities—what

strength of the discussions it is expected to evoke.

For the first time the meeting was held in the auditorium of the United Engineering Society Building. Sometime after adjournment 720 registration cards had been given out.

Directors' Report

The annual report of the board of direction showed a gain in membership of 283, as compared with 231 for the previous year. The total membership Jan. 1, 1917, was 8192.

The library now contains 26,858 bound volumes, 49,170 unbound volumes, 8043 specifications and 5275 maps, photographs and drawings—a total of 89,346 and a gain of 2638. Since Oct. 1, 1916, the library has been under the management of the United Engineering Society Library Board, although still on the shelves of the society house. It is expected that shelving will soon be ready at the Thirtieth Street building.

The plan for increasing the height of the United Engineering Society Building three stories is being executed. The four columns extending through the present building have been completed, and a contract for the remaining work has been awarded. While there has been much delay on account of slow deliveries, it is hoped that the building will be ready for occupancy toward the latter part of the coming summer. The Fifty-seventh Street property has been placed on the market.

Building Expenses

The society has paid \$54,000 toward the building expenses, for which the society was to furnish the funds, the total cost not to exceed \$250,000. The building committee finds, however, that due to the great and unexpected increase in the cost of materials the total cost will exceed \$250,000, and has asked each of the four societies to become responsible for its share of an additional amount, which it is estimated will be \$50,000.

In order to raise funds to meet the necessary expenses of building, a mortgage of \$200,000 at 5 per cent has been placed upon the society's property, which was entirely free. Only \$20,000 of this amount was drawn at the time of the execution of the mortgage, and arrangements have been made by which additional amounts will be received

New President of American Society of Civil Engineers



GEORGE HERNDON PEGRAM

might be called the human side of engineering—would not down. The question of the engineer's education, his early association with engineering societies, his opportunities for marketing his services to better advantage in both this and foreign countries and the desirability of his taking a much larger part in public affairs, all these matters were discussed. On the other hand, none of the technical reports were discussed in their technical aspects, although the final report of the committee on concrete and reinforced concrete was presented and accepted, and that of the committee on valuation was also accepted subject to such revision as the committee cares to make on the

when needed, thus saving unnecessary interest charges.

What Is an Engineer?

The first special committee to report was that on engineering education. After its chairman, Desmond Fitzgerald, had explained briefly why the committee had been unable to make a report, Dr. C. R. Mann spoke briefly on the progress of his investigation. The questions sent out during the last year, he said, confirmed exactly, regardless of the length of experience of those who replied, the conclusions previously reached as to the relative importance of the various attributes needed by engineers. As to what this could show the engineering school, he mentioned two principal points. He said engineering education must give the student enthusiasm, or "motivation," and common sense, or understanding of the relationship between things. As an instance of failure to do this, Dr. Mann mentioned the division of instruction into such departments as that of mathematics, which are likely not to know the specific needs of the engineer.

Dr. Mann hopes to be able to present a complete report within a few months.

Roads and Concrete

The special committee on road construction and materials, through George W. Tillson, stated that because of the absence of its chairman on military duty in Texas, it had been unable to make a final report, but hoped to do so next year. Its progress report it had shaped to the suggestions made at the annual meeting last year, making the report broader in scope.

The final report of the special committee on concrete and reinforced-concrete, presented by its chairman, J. R. Worcester, was received with the thanks of the society.

Compensation of Engineers

Nelson P. Lewis, chairman of the committee on employment and compensation, presented the committee's final report. Suggestions made by two or three members that the committee had not got at the heart of the question included statistics on seventy-one members of two groups of engineers in Connecticut cities, all eligible for membership in the society. Their average compensation was \$1,480. Ten were members of the society, and their average was \$3,270. The views of the chairman, however, that many in engineering offices could not accurately be termed engineers, and that the committee had done as well as possible with the material available, evidently bore weight, and when the question was put to a vote only one dissenting vote was heard.

The report of the committee on valuation was presented as final, with the proviso that the committee revise it if it saw fit in response to the discussions that are expected to be evoked by it. Charles Rufus Harte, speaking for the American Electric Railway Association, suggested that before closing the

matter the committee confer with the valuation committees of other organizations relative to variations in terminology. Progress was reported by the committee on steel columns and struts, that on stresses in railway track and that on the bearing value of soils. As the chairman of the committee on national water law was not present, that progress report was not read.

More About the Engineer

Under new business a motion was made that the board of direction be asked to consider the appointment of a special committee to investigate opportunities for American engineers in Russia and South America. Another proposed that consideration be given to the forming of student branches in the leading technical schools, similar to those of the American Society of Mechanical Engineers.

The most radical motion, by P. M. Churchill, called upon the board to consider the appointment within a month of a committee of three to formulate plans for the better marketing of engineering services, other societies to be co-operated with, the committee to be authorized to spend not to exceed \$5,000 and if necessary employ a competent engineer to handle its investigation and a report to be made at the next annual convention. The motion was embodied in a long letter from Mr. Churchill, who proposed the investigation just terminated by the discharge of the compensation committee, and who evidently was not wholly satisfied with the findings of that committee. He pointed out the desirability of statistics as to lost time, traveling expenses and other matters that would have a bearing on net compensation. He also emphasized the need for engineers to take a larger part in the administration of engineering expenditures, and called attention to the desirability of engineering exchanges to enable communities seeking competent engineering services to find them.

Engineering Exchange Needed

Brig-Gen. W. H. Bixby, formerly chief of engineers, U. S. A., emphasized the latter point by stating that he had known of cabinet officers seeking capable engineers and being unable to get any assistance whatever from the American Society in the matter. Another speaker pointed out that the engineering exchanges were among the most important functions of European societies.

All three of the foregoing motions were carried. The hour was then so late, the meeting having begun half an hour late, that the incoming president, George H. Pegram, spoke only a few words, after which the meeting adjourned.

Prizes were awarded during the year as follows: Norman Medal, to J. A. L. Waddell, for his paper on the possibilities of high-alloy steel in bridge construction; J. James R. Croes Medal, to C. E. Smith, for the paper on the history of the Little Rock Junction Railway bridge; Thomas Fitch Rowland

Prize, to E. L. Sayers and A. C. Polk for that on Lock 12 development, Coosa River, Alabama; James Laurie Prize, to William G. Grove and Henry Taylor, for that on the reconstruction of the Norfolk & Western's Kenova bridge; Collingwood Prize for juniors, to Harold Perrine and George E. Strehan, for that on cinder-concrete floor construction.

Officers for the coming year were elected as follows: President, George H. Pegram; vice-presidents, George W. Kittredge and George S. Webster; treasurer, George W. Tillson; directors—district 1, Alfred D. Flinn and Lewis D. Rights; district 3, William R. Hill; district 5, Arthur P. Davis; district 7, W. L. Darling; district 12, R. H. Thomson. Members of nominating committee—district 1, R. S. Buck; district 3, D. B. La Du; district 5, John S. Conway; district 6, A. J. Himes; district 10, A. O. Ridgway; district 11, Louis C. Hill; district 13, W. C. Hammatt.

Arrest Engineer Who Used Professional Connection to Defraud

Robert J. MacNoll, alias James Craig, bridge engineer and draftsman, who has during the last month obtained positions with consulting engineers of St. Louis and used those associations as a means of falsely obtaining funds, has been arrested, and will be charged with forgery and grand larceny. The gentleman in question entered the employ of C. E. Smith, consulting engineer of St. Louis, Dec. 2. Mr. Smith advanced funds, yet despite this kindness Mr. MacNoll used his connections with Mr. Smith, the closeness of which he enlarged on, to obtain money under false pretenses.

Mr. Smith, who put private detectives on Mr. MacNoll's trail, but had not yet found his man, announced the details at the Jan. 10 meeting of the St. Louis Engineers' Club. On information furnished by one of the members, Mr. MacNoll was found under the name of James Craig, and handed over to the authorities on the charges mentioned.

Henry Gordon Stott Dead

Henry Gordon Stott, superintendent of motive power of the Interborough Rapid Transit Company, since 1904 in charge of the entire operating force, including the subway, elevated and surface lines, died Jan. 15 at his home at New Rochelle, N. Y., in his fifty-second year. He was born in 1866 at Stennis, Scotland, and studied engineering at the College of Science and Arts, Glasgow, now the Glasgow and West of Scotland Technical College. Mr. Stott was employed on many electrical engineering works in England and on a power plant in Spain previous to his arrival in the United States in 1891. Ten years with what is now the Buffalo General Electric Company preceded his appointment with the Interborough in 1901. Mr. Stott has been a member of the American Society of Civil Engineers since 1908 and was made a director of the society in 1911.

Illinois to Consolidate Its Governmental Agencies

More than 100 existing governmental agencies in Illinois will be combined into nine departments if the "administrative code" which Governor Lowden is advocating is made a law. The directors of the departments will form the members of the Governor's cabinet and will be appointed by him. There will be numerous bureau chiefs under the di-

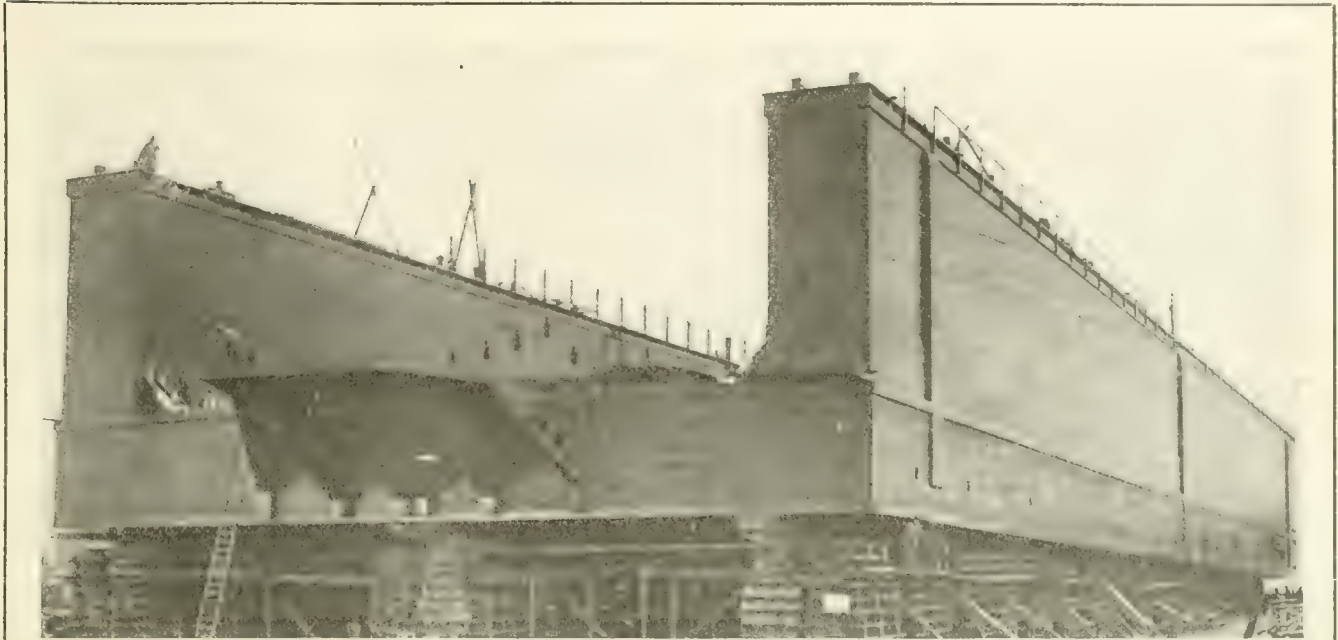
five normal schools, the State entomologist, legislative reference bureau and State historical library. Indications point to a speedy passage of the bill.

No New Chinese Railroad Contract

Newspaper reports dated Jan. 15 state that the Chinese Government has contracted with the Siems-Carey Railroad & Canal Company of St. Paul for the construction of an additional 300

New Jersey Governor Recommends State Highway Tax

Gov. Walter E. Edge, in his inaugural address Jan. 16 at Trenton, N. J., included in his recommendations many measures of interest to engineers. That the Passaic Valley Sewerage Commission be discontinued and its duties be turned over to the health commissioner, or to the North Jersey Water Supply



Drydock 450 Feet Long, with Square Ends, Launched at San Francisco

WHAT IS SAID to be the largest floating drydock ever constructed was successfully launched recently at Hunters Point, in San Francisco Bay, by the Union Iron Works. Although the structure is 450 ft. long, with square ends, it was launched end-on, in just the same manner as are large vessels. A careful inspection of the interior of the hull immediately after the launching showed that the impact which the square-

ended bow received as it entered the water had not injured the timbers in the slightest. The drydock is 100 ft. in extreme beam and has 80 ft. of clearance between wings. There are a solid keelson 16 in. square and two 10-in. sister keelsons. Both floor and deck are supported by timbers 16 in. square and 100 ft. long, each of which is braced with a double truss of heavy timber. There are 12 transverse watertight com-

partments. The depth from deck to floor is 12 ft. 9 in. and the extreme height from floor to the top of the wings is 42 ft. The dock will be flooded by twenty-two 12 x 24-in. valves. Ten motor-driven centrifugal pumps will be installed for pumping it out. The maximum lifting capacity of the dock will be about 12,000 tons. Dan Gillis of the Union Iron Works was in charge of the construction and the launching.

rectors, the scheme of organization being patterned after that of the federal government. The civil-service commission will remain an independent body and have jurisdiction over employees in all departments.

Departments having bureaus of interest to engineers and contractors are as follows: Under the department of labor it is proposed to consolidate the labor commissioners, free employment agencies, State factory inspection service, industrial board and the State board of arbitration. Under the department of public works will come the highway commission, the three canal and waterway commissions, Illinois park commissions, State architect, supervising engineers, the State examiners of architects and structural engineers. The department of health will include the boards of health, the food commissioners and food standard commission; but the State water survey and the geological survey will be placed under the department of education along with

miles of railway. Officials of the American International Corporation, the company that is financing the contract, state that to their knowledge no new contract has been signed. It is their opinion that the "300 miles of new road" is probably a part of the 1100 miles contracted for several months ago, and surveys of which have probably been started.

Introduce License Law in Indiana

A bill will be introduced in the Indiana legislature, now in session at Indianapolis, which will require all architects practising in that state to secure licenses. The measure is patterned after the Illinois statute, which has been in operation for nineteen years. Civil engineers will be exempted from the law's provisions unless they do the actual work of architects.

The bill provides for a board of five examiners composed of one consulting engineer, one member of the faculty of Purdue University and three architects.

Commission, was among the first recommendations. The new governor also urged a state highway system financed by direct state tax instead of by bonds, the creation of a state highway commission of eight members, to include three engineers, the universal installation of the patrol system, even to the extent of denying state aid to those counties which fail to provide for road patrols.

Public ownership of the waterfront, the co-operation of the state with cities in building marine terminals, the grouping of cities to take advantage of the law whereby streams may be dredged by the federal government, and greater co-operation by the state in movements to tunnel under the Hudson and bridge the Delaware river were also advocated. The extension of the state-use system, including work on roads by convicts and the abolition of prison contract labor under any subterfuge, were included in the prison reforms called for.

May Put Imperial Valley Works Under Federal Control

To determine on what conditions the credit and assistance of the Department of the Interior may be extended to the Imperial Valley, California, to complete the irrigation and flood-protection systems begun by the people of the valley, Joseph Jacobs, consulting engineer of the U. S. Reclamation Service, has been directed to investigate and report on the engineering works already constructed and those contemplated. Investigation to determine the advisability of placing under federal control the engineering works of the Imperial Irrigation District, comprising 750,000 acres, was asked by the directors of the district, the board of supervisors of Imperial County and the Imperial County Farm Bureau. This request was made by these organizations following the report made several months ago by Prof. Elwood Mead, who was engaged by them to make a survey, and who recommended that the works be placed under federal control.

First Annual Report for 1916 Comes from Columbia, S. C.

The first annual report for the year 1916 which has been received by the Engineering Record is from T. Keith Legaré, city engineer of Columbia, S. C., where the commission form of government is in operation. In view of the fact that municipal annual reports appear frequently a year or more late, it is to be noted that Mr. Legaré's report was submitted to the City Council on Jan. 9, the date of its first meeting in 1917. Mr. Legaré presents a concise statement of progress on the city's large-scale sewer and water-supply extensions, together with the year's work of the street department. For the ensuing year he recommends a system of street improvements involving gravel surfacing treated with asphaltic oil. The construction of new storm-water drains also is advocated.

Will Electrify Chicago Suburban Traffic Only

Electrification of its suburban traffic only in Chicago constitutes the offer renewed by the Illinois Central Railroad in a communication sent last week by C. H. Markham, president, to the City Council committee on railway terminals. The road has offered to electrify its suburban service, which involves complete relocation of the suburban tracks on the western side of the right-of-way for about 8 miles, a subway under the proposed terminal, complete electrification of 100 miles of track and new suburban passenger equipment.

Mr. Markham points out that the road is taking a step in advance of others within Chicago and that it is unfair to bind it to do further electrification. The proposed work will eliminate 500 steam passenger-engine movements per day north of Twelfth Street, producing about 70 per cent of the present smoke.

Half of Harbor Bill Said to Be Waste of Money

Board Similar to Interstate Commerce Commission Needed, It Is Thought

The contention that about half of the \$38,000,000 appropriated in the pending Rivers and Harbors bill is a waste of money is made in a minority report on the bill to be filed in the House this week by Representative James A. Frear of Wisconsin, a Republican member of the Rivers and Harbors Committee.

"A high-class board similar to the Interstate Commerce Commission is needed for the intelligent management of waterways improvements," said Mr. Frear. "Some such board controls waterways improvements in other countries wherever an intelligent waterways system has been put in force."

The Frear report says commerce on the Mississippi, Missouri, Ohio, Tennessee and Cumberland rivers and inland waters generally, excepting deep waterways, has diminished from 80 to 90 per cent in the last forty years.

"During that period," continues the report, "the government has appropriated \$159,000,000 for the Mississippi, \$60,000,000 for the Ohio, \$22,000,000 for the Missouri, and proportionately large amounts for other streams, while this decrease in commerce has steadily continued. Hundreds of small streams are being improved by the government with equally disappointing results. Colonel Townsend, one of the ablest of the army engineers and a member of the Mississippi River Commission, has urged a stop in waterways extravagance until one or two projects have been made commercially valuable.

\$19,000,000 Waste of Money

"Practically one-half of the \$38,000,000 contained in the pending waterways bill is wasted, including the greater part of \$18,000,000 given by the bill to eight inland streams. Army engineers have had full control in the determination of navigation needs and the amount of appropriations. Without business training, commercial knowledge or experience, this policy has resulted in wasteful projects, maintained all over the country, including those which are good, bad and indifferent. All join together annually in enormous omnibus bills. Not one project in four would pass Congress if standing in a separate bill, but omnibus measures carry those good, bad and indifferent because of the votes assured by this method."

Concrete Institute Announces Convention Program

The thirteenth annual convention of the American Concrete Institute will be held Feb. 8, 9 and 10 at the Hotel La Salle, Chicago. No sessions are planned for the afternoons of the first two days, so that members may visit the Cement Show. Meetings will be held in the mornings and at 8 o'clock in the evening. All of Saturday, Feb. 10, is to be

devoted to papers and committee reports.

Reports will be presented by the committees on reinforced-concrete and building laws, reinforced-concrete stand-pipe, sewers, concrete roads and paving, and building block and cement products. Committees on concrete bridges, chimneys and aggregates, and those on sidewalks and nomenclature will report Saturday afternoon.

Papers on concrete construction and design that will interest the contractor as well as the engineer form a program that promises to be well worth attention. Several specifications will be presented, including those for reinforced-concrete fenceposts, monolithic concrete sewers and revised specifications and building regulations for the manufacture and use of architectural stone, building block and brick.

Bids Wanted on \$1,000,000 Road Job in Illinois

Cook County, Illinois, will spend \$1,000,000 for 60 miles of hard roads this year. The first contracts will be let the first week in February and others will follow every two weeks thereafter until all of the sections from 3 to 9 miles long have been contracted for. Accessory information for the contractors bidding on the job has been worked up by the engineering staff of the county to show in map form the location of all sand, gravel and stone supplies within a reasonable distance of the various sections. Each of these material bases has been inspected so that the contractor is assured that acceptable material can be obtained from them. This does not mean that there may not be other plants, but the list is as complete as it is economically feasible to make it.

Railroad Sidings Mapped

On a second map which is to be furnished to the contractors taking out plans are shown all sections of roads to be constructed this year and all those now under construction and closed to traffic. All railroad sidings are marked with a figure which indicates the number of cars that can be accommodated. This information was furnished by the railroads, many of which stated that extensions would be provided if necessary. The map also shows the boundaries of all municipalities for the guidance of contractors. Some of the towns have traffic regulations which may preclude the use of heavy motor trucks without special permits. Camping privileges and other arrangements for housing the men may be affected in some cases.

Alternate bids will be taken for concrete of an average thickness of 7 in., asphaltic concrete 2 in. thick on a 6-in. macadam base, or on a 5-in. base of 1:3:5 concrete. Contractors are paid monthly in cash on 80 per cent of completed work. Cuts and fills have been balanced each 1000 ft. Asphaltic concrete roads must be maintained for one year.

Meters Are Barred Pending Spring Valley Valuation

A recent order issued by the Railroad Commission of California refused the Spring Valley Water Company permission to charge meter rates for residence service in San Francisco and directed the company to keep in effect the present flat rates until the commission shall fix a schedule. The commission is preparing to make a complete valuation of the Spring Valley Company's properties, as was announced on page 37 of the Engineering Record of Jan. 6. The future rates are to be based upon the findings of the commission.

One of the chief points at issue will be whether real-estate holdings of the company, which it has been claimed are not essential to the service which the company renders, should be included in the investment on which the company claims the right to earn profits.

Those who are seeking a reduction of the water rates claim that 31,566 acres of land owned by the company are not useful for water-supply purposes and should not be considered as such in any valuation of the corporation's properties fixed by the state for the purposes of rate schedules or sale of the properties to the city.

Wood-Block Paving to Be Discussed Next Week

The program for the annual convention of the American Wood Preserver's Association, to be held next Tuesday, Wednesday and Thursday at the Hotel Astor, New York City, has been prepared. Among the reports to be presented during the afternoon of the first day are those on publicity, promotion and education and on terminology, by E. A. Sterling and J. B. Card respectively.

The committee on purchase and preservation of treatable timber will report Wednesday afternoon, while that on wood-block paving will have the floor part of Thursday morning. The latter committee will recommend for adoption the specifications it submitted last year as information. It is the members' opinion that the clause pertaining to the method of computing absorption of preservatives should read as follows:

"In any given contract the blocks shall contain an average of not less than 16 lb. of water-free oil per cubic foot of wood at the completion of the treatment. Not less than 15 nor more than 17 lb. per cubic foot will be permitted in a given charge."

The committee has also prepared a specification on pitch filler.

Revise Concrete Building Code

A special committee to co-operate with the city in revising the code for concrete structures has been appointed by the Cleveland Builders' Exchange. Meetings will be held every Friday afternoon in the new City Hall, in charge of E. W. Cunningham, city building commissioner.

What Engineers and Contractors Are Doing

WILLIAM M. ACHESON, whose resignation as division engineer of division 6 of the New York Highway Department was noted in the Engineering Record of Jan. 6, has decided to remain with the highway department at Buffalo, N. Y.

L. T. PEARSALL, recently resigned from the engineering department of the Power Specialty Company of New York to become designer on furnaces and general rolling mill works for the Jones & Laughlin Steel Company. Mr. Pearsall was with his former employers for six years.

H. J. HANMER has been reappointed city engineer of Gloversville, N. Y.

J. A. WILLIAMS, formerly with A. A. Oldfield on drainage work in western Tennessee, is now with the Cuapaw Company at Bartlesville, Okla., on a geological survey.

A. J. PROVOST, consulting engineer, of New York City, is to give a series of lectures on water-supply purification and sewage treatment at Bellevue College.

RICHARD PFAEHLER, who for the last two years has been connected with the New York office of the Quebec Development Company, Ltd., and with the Southern Power Company and affiliated interests, has returned to Charlotte, N. C. He will have charge of the design of the new hydroelectric power developments at Bridgewater, N. C., and at Wateree, S. C. The Bridge-water development will include a reservoir having an available storage capacity of 12 billion cu. ft. and a power station of 27,000 installed horsepower. The Wateree project will have a powerhouse installation of 100,000 hp. Mr. Pfaehler was educated in Germany. He came to the United States in 1908, and located at Charlotte. He was associated with the Southern Electro-Chemical Company on its plant at Nitrolee, S. C., for obtaining nitric acid from the air.

W. B. BIDDLE has been elected president of the St. Louis & San Francisco Railroad to succeed the late W. C. Nixon. Mr. Biddle was formerly first vice-president of the road.

R. R. HAVENS of the U. S. Geological and Biological Survey has completed the mapping of 30 square miles along Lake Huron and is now at Lansing, Mich., preparing the completed map.

CLEVELAND TRINIDAD PAVING COMPANY has removed its office to the Arcade Building.

ARTHUR P. DENTON, retiring county engineer of King County, Washington, was the honorary guest at a dinner given recently by employees of the county engineer's office at the Northold Inn, Seattle. About forty

persons connected with the department were in attendance. Mr. Denton has served as county engineer for the last four years. For the preceding four years he was chief deputy engineer under J. R. Morrison. He is succeeded in office by S. J. Humes.

A. W. K. BILLINGS has returned from Barcelona, Spain, where for the last five years he has been manager of construction, managing director and vice-president of the Ebro Irrigation & Power Company, Ltd., and allied interests, in responsible charge of extensive hydroelectric construction and other work. More than 110,000 hp. has already been developed, one interesting feature being the construction of one of the largest dams in Europe under very unusual conditions. Previous to his work in Spain and elsewhere for the Pearson interests Mr. Billings spent two years in Pittsburgh and ten years in Cuba, principally on electric railway and power-plant construction. For two years he was in New York as engineering manager of J. G. White & Company, Inc. He has opened an office as consulting engineer at 115 Broadway, New York City, and will devote considerable attention to work in Europe and in Latin America.

FLOYD C. BROWN has been appointed assistant city engineer of San Jose, Cal.

FRED R. HESSER, formerly with the General Fireproofing Company of Youngstown, Ohio, has resigned to become sales engineer for the Fireproof Products Company of New York City, agents for the former concern. Mr. Hesser went to the General Fireproofing Company last November after four years as assistant engineer in the sanitary and highway department of the state of Kansas, and several years with the bridge department of the Kansas City Terminal Railway.

A. F. MATTSON has resigned from the city engineering department of Houston, Tex., to open consulting offices in the Beatty Building.

W. H. KUTZ, formerly with the valuation department of the Missouri, Kansas & Texas Lines, has been appointed city engineer of Parsons, Kan. Mr. Kutz spent about six years on engineering in the West before taking a course in engineering at the University of Kansas. After graduation in 1904 he engaged in contracting work at Rock Island, Mo., and later entered the real estate and insurance business. Ten years later he was appointed assistant city engineer of Oklahoma City and later became connected with the Atchison, Topeka & Santa Fe Railway. He had been in the valuation department of the Missouri, Kansas & Texas for about a year.

LEE H. POWELL has resigned as division engineer for the J. B. McCrary Company of Atlanta, Ga., to become chief engineer of road district No. 1, Cherokee County, Texas, with office at Jacksonville. It is proposed to con-

struct 100 miles of highway of local iron ore gravel with fund obtained from a \$200,000 bond issue. A maintenance fund for the next five years has been provided in the form of bonds amounting to \$50,000. Mr. Powell had charge of building part of the Dixie Highway in Leon County, Florida.

THE FIRM OF FARLEY GANNETT, consulting engineer, of Harrisburg, Pa., will hereafter be known as Gannett, Seelye & Fleming. Mr. Seelye has been associated with Mr. Gannett since Aug. 1, 1915, and Mr. Fleming has been associated with him since February, 1916. The offices have been removed to 204 Locust Street. The company has been retained by the Blue Mountain Consolidated Water Company to design a dam to form an impounding reservoir of about 300,000,000 gal. in the Kittatinny Mountains, north of Easton, Pa.

DWIGHT M. LEWIS has been made a member of the Iowa Board of Railroad Commissioners.

J. A. GUIHER, a member of the Iowa Board of Railroad Commissioners, has been made chairman of the board to succeed Clifford Thorne, resigned.

EDWARD D. CHASSEL has been appointed railroad commissioner of Iowa to succeed the late James H. Wilson.

BENJAMIN MCKEEN, formerly general manager of the Pennsylvania Lines West, and who was recently elected fifth vice-president, with office at Pittsburgh, is a graduate of Worcester Polytechnic School and of Rose Polytechnic Institute. Since 1885 he has been engaged in railroad work, a large part of that time in the maintenance departments. He had been general manager of the Pennsylvania Lines West since 1913.

A. A. MILLER has been appointed engineer maintenance of way of the Missouri Pacific Railway, with office at Little Rock, Ark.

A. A. COOK has resigned from the engineering department of the Central Railroad of New Jersey to become recorder of deeds of Mauch Chunk, Pa.

FRANK HELM has been promoted from office engineer of the Atchison, Topeka & Santa Fe Railway, western lines, northern district, to division engineer at Slaton, Tex.

GEORGE W. KNOPF has opened consulting offices in the Pennsylvania Building, Philadelphia, to specialize in the design and construction of industrial plants.

R. W. NEWTON has been made road engineer of St. Louis County, Minnesota, with headquarters at Duluth. He was formerly assistant deputy engineer of the Minnesota State Highway Commission.

H. MALCOLM PIRNIE, assistant engineer for Hazen, Whipple & Fuller, consulting engineers, of New York City, has been made a member of

the firm. Mr. Pirnie was graduated from Harvard University in 1911 and immediately thereafter entered the employ of his present associates, then the firm of Hazen & Whipple. Mr. Pirnie has recently been engaged on investigations of new sources of water supply for Watertown, N. Y.

F. T. HATCH, chief engineer of the Vandalia Railroad, with headquarters at St. Louis, has been appointed chief engineer maintenance of way of the St. Louis system of the Pennsylvania Lines West of Pittsburgh. This is the result of a recent reorganization.

HERMAN FINK has been appointed chief engineer of the Anderson-Cottonwood Irrigation District, Shasta County, California, to succeed E. I. Davis.

GOODMAN CONTRACTING COMPANY of New York City has removed its office to 90 Alexander Avenue, Borough of the Bronx.

Y. D. VESELY, formerly surveyor in the U. S. Army engineer's office at Memphis, Tenn., recently accepted a commission as second lieutenant in the army. He is now located at Fort Leavenworth, Kan.

R. H. STODDARD, superintendent for Welch Brothers & Hannaman, has been transferred from Kalispell, Mont., to Boise, Idaho, to direct work on the U. S. post office.

J. R. THOENEN has sold his interest in the firm of Curtis & Thoenen, road contractors, of Greenville, Ohio, to take a position as superintendent of the Garson (Ontario) mine of the Mond Nickel Company, Ltd., of Canada. Mr. Thoenen left the Mond company last year to engage in the contracting business.

JOSEPH R. GREENWOOD has resigned as general manager of the Ballwood Company to become associated with Charles H. Higgins, architect and engineer, New York City.

R. C. HATFIELD, superintendent for W. C. Owen & Company, of Cleveland, has moved to Ashtabula, Ohio, to superintend the erection of the new plant of the Pearce Tire & Rubber Company.

BERT W. MACY, engineer, of Salem, Ore., has been appointed city engineer of that city for the ensuing two years.

C. C. VAN ARSDOL has been retained by the commissioners of the Clearwater highway district, near Lewiston, Idaho, as consulting engineer for road construction to begin at an early date.

WHARTON CLAY, structural engineer, has been appointed executive secretary of the Military Training Camps Association of the United States, Central Department U. S. Army. The association works in co-operation with army headquarters, and its aim is to organize the business men of the Middle West

in the training-camp movement. Senior camps are to be held at Fort Sheridan, Ill., Fort Snelling, Minn., and Fort Riley, Kan. The method of procedure is to work in conjunction with business men and technical societies. Six men will be put in the field to handle the work under Mr. Clay, who was formerly in the engineering and sales department of the U. S. Gypsum Company. He will return to the commercial field at the conclusion of this campaign.

ALFRED KETTENBACH, assistant city engineer of Lewiston, Idaho, has been retained by the commissioners of the Clearwater highway district, near Lewiston, to take charge of road construction in the district. Surveys will be started at once.

J. D. MCLAUGHLIN, who resigned some time ago from the engineering department of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has been appointed to a position with the Baltimore & Ohio Railroad, with office at Jenkins, Ky. He will have supervision over the Shelby Creek branch between Shelby Junction and Jenkins, Ky.

L. B. ABBOTT, who for five years has been resident engineer for the Consolidation Coal Company in the Jenkins-McRoberts-Burdine territory in Kentucky, has been promoted to chief engineer over the company's plants in the Elkhorn and the Miller's Creek fields in eastern Kentucky. Mr. Abbott went to Kentucky five years ago from the Fairmont region of West Virginia.

C. R. ANDREW has been transferred from Wheeling, W. Va., to the U. S. engineer office at Charlestown, W. Va., in connection with work on the Kanawha River.

PARKER & MOCK is the name of a new engineering and architectural firm that has been incorporated by J. C. Parker and E. T. Mock. The company has opened offices in the National Realty Building, Tacoma.

M. R. LEWIS, U. S. assistant irrigation engineer, has been transferred from Twin Falls to Boise, Idaho.

Civil Service Examinations

United States—Examinations will be held Feb. 7 for junior land appraiser, salary \$900 to \$1,500. Applicants should fill in Form 2039. Applicants for position as aid in the Coast and Geodetic Survey will be examined Feb. 7 and 8. Examinations will be held Feb. 27 and 28 for assistant engineer in forest products, salary \$900 to \$1,200. Form 1312 should be filled in by applicants for the last two positions.

On March 14 examinations will be held for aid and computer in the Coast and Geodetic Survey, draftsmen of various kinds, and for junior civil engineers. Examinations for topographic draftsman (Panama Canal) and for laboratory assistant (Bureau of Standards) will be held April 11.

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Highway Engineers by Brevet

THIRTY-ONE deputy highway engineers, and only two of them trained in the technicalities of road building! This, according to press accounts, is the personnel of the organization in charge of county highways in a state of the Middle West. The newly appointed officials, we are informed, "are farmers, clerks and janitors," but it should be noted that "several have had experience with machinery." The one ray of hope which this statement appears to offer is obscured by its failure to be specific. What kind of "machinery"? There are all sorts—political as well as road-building. Still, why shouldn't a sober, intelligent janitor make a good deputy county highway engineer? Why shouldn't he be elevated by brevet, as it were, from cellar to street level? There is precedent for such action—in the Gilbert and Sullivan opera "Pinafore," for example. The "office boy in an attorney's firm" rose to be "ruler of the Queen's navee"—and all because he knew how to "polish up the handle of the big front door." If admirals can be developed from polishers of front-door handles, why cannot janitors blossom out into county highway engineers? The answer, of course, is that they can. The main point, however, is that the admirals, as characters in opera, spend only stage money. Janitor-highway engineers, on the other hand, handle hard cash.

Quartz-Gravel Concrete and Fires

ASERIOUS question is raised by Ira H. Woolson, consulting engineer to the committee on construction of buildings of the National Board of Fire Underwriters, in his exhaustive investigation and report of the results of the fire in a warehouse at Far Rockaway, N. Y., abstracted on page 98 of last week's issue of the Engineering Record. Is pure quartz-gravel aggregate unsafe in concrete used for fire-resistive purposes? The evidence presented by Mr. Woolson throws a strong suspicion upon this kind of aggregate. When such structural damage, which, in comparison with the temperatures attained, is relatively much greater than that in the memorable Edison fire of 1914, occurs in a so-called fireproof building subjected to flash fires of short duration, it is essential to the future of this type of structure to demonstrate the cause and avoid its recurrence. Even granting that part of the observed failure in the case here reported may have been due to insufficient concrete protection for the reinforcing steel, the other investigations cited by Mr. Woolson, showing the effect of heat on quartz-gravel concrete, reported as long ago as 1907 and apparently never disproved, and

the cases of beam failures observed in this fire where concrete thickness was ample, make the occurrence a most notable one. It should result in exhaustive investigation, as this matter has important economic significance, especially in the vicinity of New York City.

Protection of Primary Natural Resources

THE member organizations of the Chamber of Commerce of the United States have, by a large majority, approved of the proposal that business interests be permitted to make co-operative agreements under federal supervision in those industries which involve primary natural resources, on condition that the agreements in fact tend to conserve the resources, to lessen accidents and to promote the public interests. The vote stood 1034 in favor of the project and 110 against. It has been shown that competitive conditions in mining and lumbering particularly tend to a wasteful policy of removing these resources and to the use of methods which often endanger life. If the producers, however, were allowed to enter into agreements which would permit a pooling of interests, a distribution of territory, and a limitation of production in certain sections to fit market conditions, the wasteful conditions could be entirely eliminated or very greatly minimized. The permission to co-operate, however, would only extend to the resources of a primary character and would not disturb the application of the Sherman Law to finished or fabricated material. The vote is in accord with sound thought on the conservation of natural resources and with the practice in foreign countries. Should Congress hearken to the voice of the business men of the nation, the Federal Trade Commission would be empowered to permit the execution of co-operative agreements in the fields suggested. Unfortunately, Congress seems to be panic-stricken on the matter of combinations and trusts and it will need much educational work to persuade its members that the proposed measure can be put into effect without detriment to the public interests.

Are Engineers Professional Men?

THERE is food for thought in the extract from an address by Prof. F. H. Newell printed on page 146 of this issue. He gives a clear-cut definition of that which stamps one as a "professional man" and from his definition justifies some of the activities of engineering societies which the conservatives have criticized. The distinctive feature of the professional man, Professor Newell says, is that he "does not work under the imme-

dictate direction of some other person, nor does he perform certain set operations within certain hours. He is called in not to carry out instructions of an employer but, on the contrary, to dictate to the man who ultimately pays the fee when, where and how certain things must be done. He ceases to be a professional man the moment he takes orders from an employer."

This definition being accepted, and few will dispute it as being the strict definition of that which constitutes a professional man, it is apparent that our engineering societies are composed most largely of men who are not yet in the professional category, but are headed in that direction. The leading engineering societies, when first established, aimed to serve only the truly professional element in their membership by building up an organization with high prestige. They emphasized the high plane of the calling of their members. When searching analysis, however, is made of the needs of the non-professional element of the membership, there is ample justification for those activities which are essentially of the type of "service." These have not found favor with the larger organizations, but have been made much of, and very properly so, by the smaller societies.

In our judgment, Professor Newell is thinking straight in his deductions from his definition. His words should stimulate discussion and the discussion, we hope, will result in strengthening the "service" activities of even the most elevated of the national engineering organizations.

Action on Water Problems

REALIZATION of the uses to which hydroelectric energy can be applied has increased at a record rate during the abnormal conditions of the last two years, but meanwhile there has been no change in the control of water rights which would encourage a degree of development comparable to the broadening field. Hope still clings to the prospect of federal legislation that will improve the present situation, but while that action is deferred there are phases of the water problem which the individual state legislatures can clear up. California realized this and appointed a carefully chosen committee to make an investigation and to report on action which the state Legislature of 1917 might profitably take. Heretofore if there has been any state policy at all it has been one of "intensive restriction." Therefore it is a most encouraging sign to find in the report of this committee, prepared after more than a year's investigation, recommendations for action along lines calculated to encourage development.

The report is abstracted at some length elsewhere in this issue because there should be in other states as well as in California a keen interest in the purpose and results of this study. The committee wisely states that a perfect organization cannot be built in one year nor by one legislature and that to attempt too much is frequently to lose all. Nevertheless there has been no hesitancy in recommending radical changes where it

has seemed that the possible danger in such a move would be less than a continuation under the present disadvantages.

Some opposition has appeared, even within the conference itself, as is indicated by a partially dissenting minority report. The personnel of the committee, chiefly state office holders, did not include any representatives of power companies or other interests directly concerned, though of course the power companies, irrigationists and all others interested were given a hearing. However, very fair consideration seems to have been accorded all interests involved, and on the whole the report has been received with much favor. Organizations with interests at stake now have authoritative facts and figures to back up their demands upon the legislature for action. No matter in which direction they tend, the interests which are hoping and working for a larger development of water resources will welcome effort directed toward getting at the real facts of the situation and recommending at least a definite policy and purpose in the control and development of water powers. Once under way in the right direction, the course can be shaped more exactly. Almost anything would be better than passively ignoring changing conditions and the opportunities that attend them.

Where Original Cost Was Found

ORIGINAL cost is reported by the Interstate Commerce Commission in its tentative valuation of the Winston-Salem Southbound Railway. The road is a small one, with only 90 miles of line, and was opened for traffic only six years ago. Hence the original records were largely available. Furthermore, that the embarrassing complications that may arise in older properties from renewals differing from the original construction were not considered applicable is evidenced by the statement that "the amounts may not in every instance represent the exact cost of property units now in place, as some renewals doubtless have been made." This is probably a conservative assumption as far as crossties, at least, are concerned.

As the commission still declines to give the reproduction cost of land, no comparison can be made between its total original cost and its reproduction cost. Exclusive of land, however, the original cost of the road to date is found to be a trifle more than the cost of reproduction new, the respective figures being \$5,153,996 and \$5,121,188. In view of the constantly increasing prices of materials and labor, this is rather surprising, even though, because the valuation was made as of June 30, 1915, the extreme prices of the last 18 months would not figure. Although the commission allows the company slightly more for bridges, trestles and culverts, and considerably more for ballast than the book costs, it allows less for grading, ties and rails, and cuts nearly in half the original-cost figures for track-laying and surfacing, crossings and signs, and signals and interlocking. For equipment it allows practically the identical original-cost figures.

For general expenditures it allows an increase of 50 per cent.

With depreciation of \$368,182 deducted, the reproduction cost of road and equipment is \$400,000 less than the original cost. In the matter of land, the commission is unable to separate the carrier land from the non-carrier land in original cost, but the present value of all land is given as \$135,000 more than its original cost. Thus what the state commissions might consider the proper reproduction-cost figure for the whole property is about \$265,000 less than the original-cost figure. If these amounts are ultimately sustained, it will be interesting to see whether the state commissions argue for original cost as vigorously in this particular case as they usually do.

An Unbalanced Report

ANYONE who has followed the brick-paving art in this country will read with disappointment the report of the committee on road materials of the American Society of Civil Engineers, presented last week. It shows a lack of contact with the best thought in brick-road construction. While there are a number of minor delinquencies, space will not permit their discussion here.

Suffice it to point out that the committee devotes but two sentences to the modern monolithic type of construction and there casts suspicion on the type because it is "less capable of absorbing shock" than roads where bituminous filler and sand foundations are used. In other words, the new type—so heartily approved by those who are competent to speak on brick-road construction—is accorded a mere mention, coupled with a turn of thought that gives preference to a construction which the best thinkers in the brick-road field regard as obsolete. Furthermore, the report gives equal weight to a bituminous cushion. This is purely experimental and has no standing with brick-pavement constructors. Then, too, the entire chapter on the cushion course deals with resiliency, whereas the whole tendency in brick-pavement work is toward monolithic construction.

Another indication of a lack of sympathy with the best thought in brick-pavement construction is the very brief reference, in connection with a discussion of the bituminous filler, to the lower cost of making street openings where the bituminous type of filler is used. Brick-road builders aim to get the best construction from the standpoint of the traffic which the street is to carry, knowing that the area of cuts is small compared with the total paved area. Those who argue for bituminous fillers on the basis of lower cost in making street openings are arguing on accidentals and neglecting the essentials.

The report, with reference to the brick pavement section, is a reflection not so much upon the committee, for the members have undoubtedly given of the best of their experience, but upon the society which allows an unbalanced committee on so important a subject to continue year after year. There are on the committee

men who are widely known for their experience in asphalt, stone-block and wood-block construction. We fail to recognize any men in the group of seven, however, who are conspicuous as authorities on brick roadways or even on concrete construction. The committee is badly in need of reorganization.

Americanization

THE WORD "Americanization" has come within the last two years to have a very definite significance. It means the transformation of the immigrant into an American, first, by teaching him English, and then by educating him up to American standards and instilling in him a love for American institutions. Only those who have dealt much with the immigrant know what a task this is, and also how great is the reward for any intelligent effort put forth. Only recently has the full significance of the problem been realized.

The instrumentalities through which Americanization is to be brought about are many. Fundamentally, they are of an educational character, but conditions within industrial plants, and particularly the character of management, exercise a large influence on the progress which the immigrant makes. Furthermore, if Americanization is taken in its broad sense, it applies not only to the immigrant, but also to the American-born worker, for thousands of them are not Americans at heart, and do not appreciate the conditions under which they live. Their self-respect, their outlook is raised by educational effort in their behalf, by fair treatment on the part of the management, by sanitary and cheerful surroundings, by proper care after injury, and support of their dependents under reasonable conditions in case of death resulting through their occupations.

Not only are these some of the elements that affect the productive capacity of a plant, but each, in order that it may be kept in its proper place and that the industry may profit to the utmost from it, needs careful scientific analysis, and this only the engineer, of all the men engaged in industry, is capable of giving. It is for that reason that Americanization and "industrial Americanization," a term recently coined, have special significance for the engineer.

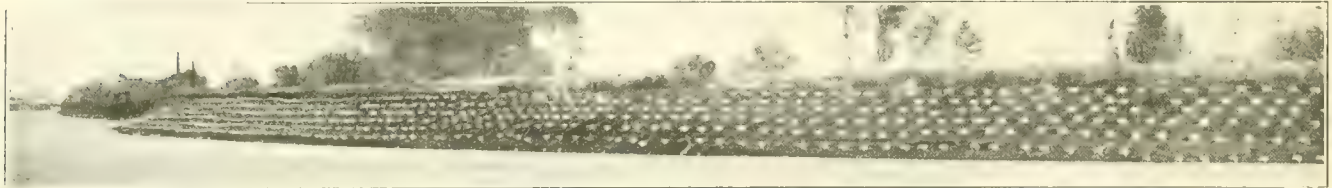
This relationship of the engineer to Americanization was brought out at a dinner given by the Immigration Committee of the Chamber of Commerce of the United States of America on Friday of last week. Dr. Ira N. Hollis, president of the American Society of Mechanical Engineers, speaking at the meeting, pledged the support of engineers in any plans that the chamber or its immigration committee might make. Far-seeing engineers fully appreciate their responsibility and opportunity in this movement, but it is hoped that either a group of the engineers who attended the immigration committee's meeting or the committee itself will take the initiative in placing clearly before all the engineers of the nation the part they can play in the Americanization of our industry.

Types of Bank Protection on the Sacramento River Compared

Costs Given for Methods Suited to Various Stream Conditions and Land Values
—No Scheme Wholly Satisfactory, But Weighted Brush Mattresses Preferred

By NATHAN A. BOWERS

Pacific Coast Editor, Engineering Record



WILLOW-BRUSH MATTRESSES WEIGHTED WITH CONCRETE MOST COMMON ON SACRAMENTO RIVER

SEVERAL types of bank protection are found on the Sacramento River, depending on stream conditions and land values. None applied to date have proved wholly satisfactory, considering both their cost and their effectiveness. Weighted brush mattresses, however, costing about \$10 per linear foot, seem to be the most popular. The purpose of this article is to compare the different forms of protection that have been used, together with the conditions that have determined the forms.

THE SACRAMENTO RIVER

The Sacramento River drains the entire central valley of northern California and carries to the sea the melted snows of the Sierra Nevada and Coast ranges which border the valley on either side. Governed largely by weather conditions in the higher altitudes, its flow ranges from a normal minimum of about 5500 sec.-ft. during the late fall to the flood of 559,000 sec.-ft. which occurred in March, 1907.

The grade in the channel averages about 2.5 ft. per mile in the 50 miles between Red Bluff and Chico Landing, while below Sacramento it varies from about 0.1 ft. per mile at low water to about 0.5 ft. per mile at high water. The total fall is less than 300 ft. in the 250-mile stretch between Red Bluff and the mouth. The bottom land on either side is fertile and valuable, but large areas in the lower part of the valley are below high-water level, and their value depends on the use of levees. The tops of many of these levees are 25 ft. above adjacent lowlands, the farmers living upon the lands cultivated.

MUCH LAND TO BE RECLAIMED

Much more lowland will be reclaimed upon the completion of the "Bypass" project, which will provide a separate channel or short cut to the mouth for carrying off all flow above a certain amount. Meanwhile, extensive diking is necessary, and as sand is usually the only material available the dikes require protection on the river slope wherever there is a strong wave or current action. Since the river height varies as much as 30 ft. in some places where slope protection is required, this work can be very costly unless some simple form of construction is adopted. On reclamation districts

1000 and 1001 there are 96 miles of levees, ranging in height from 9 to 25 ft., the average along the river being about 15 ft. Slopes of 2:1 and occasionally even steeper slopes are used, but the best practice requires a slope of 3:1 on the river side.

VARIETY OF USES OF LAND

Unlike the Colorado or the Mississippi, the Sacramento River traverses, within a few score miles, territory suited to a wide variety of uses, its needs ranging from no irrigation at all to extensive irrigation requirements. The value of the land, and likewise the funds which it is feasible to spend for dikes and dike protection, also vary between wide limits, so that on the Sacramento River the desideratum may be simply the most effective bank protection, or it may be the best bank protection that can be built within the limits of a specified amount per foot. Another point of difference from larger streams is that the shorter duration of the flood period decreases the danger from dikes long subjected to saturation.

Because of the increased economy of diking when large areas are involved, there has been popular approval of a combination of interests of flood-protection work. This has been facilitated by the activities of the State Reclamation Board and the California Débris



SERIES OF DEFLECTORS IN RECLAMATION DISTRICT 1000 DESIGNED TO CAUSE SILT DEPOSITS ALONG BANK DOWNSTREAM

Commission, and in future work there is no excuse for not taking every advantage of all that has been learned in the new designs thus far tried out. Slightly under 300,000 acres are now under dike protection in the Sacramento Valley. Land subjected to floods held at \$10 to \$20 per acre often becomes worth \$200 to \$300 per acre after the dikes are in service.

WEIGHTED BRUSH REVETMENT

After some experiment with flexible mattresses made of brush fascines and cables, the State Engineering Department developed a plan which has been used with slight modifications for many years, and more revetment of this type than of any other has been built. It consists of a mattress built of fascines of willow brush from 8 to 12 in. in diameter and about 20 ft. long, which are laid double, with broken joints, and woven together with cables spaced about 8 ft. apart.

Before the mattress is started a line of concrete anchors is placed on top of the levee and connected up by a $\frac{3}{4}$ -in. cable. If the material on the levee is very firm,

weaving continues on the cables, which are supported over the water by planks; the barge is held off shore by spars or struts, together with shore lines, and when the desired mattress width has been completed and the concrete blocks are ready, the barge is shoved away, permitting the structure to sink. This mattress, being flexible, will continue in service even if the current cuts away the slope beneath it, because the weights drop down and the mattress adjusts itself to any slope.

GRANITE BLOCKS INSTEAD OF CONCRETE

Granite blocks have been substituted for the concrete weights in some of this work, at a considerable saving in cost. Granite blocks ranging up to 200 lb. in weight have been used at a cost as low as 55 cents per block. These blocks are drilled and the cable is riven through the holes. Where concrete blocks have been cast on the mats it has not been found worth while to use forms over again, so new forms were built for each block. On a small job the form cost has amounted to about \$3.47 per cubic yard, where the total concrete cost has been

PLACING A 3-INCH PAVING ON WELL-COMPACTED LEVEE—SUCCESSFUL PAVING OF THIS TYPE IS FOUND IN DISTRICT 307, 15 MILES SOUTH OF SACRAMENTO—REINFORCED WITH WIRE MESH. IT HAS BEEN IN SERVICE SIX YEARS



patent screw anchors such as are used in telephone pole-line construction are used in place of concrete deadmen. At 8-ft. intervals $\frac{3}{4}$ -in. cables are attached to this anchor line and laid down the slope of the embankment to barges floating in the stream. On top of these cables the fascines are placed and woven together.

CONCRETE BLOCKS FOR SINKERS

After the weaving is finished another series of $\frac{3}{4}$ -in. cables is placed on top and immediately above the supporting $\frac{3}{4}$ -in. cables, and the cables above are lashed to those below at 6-ft. intervals. The cable placed on top terminates at the upper edge of the mattress, where it is clamped to the cable beneath. At the lower edge of the mattress both cables terminate in concrete blocks about $2\frac{1}{2}$ ft. square and 12 in. thick, cast on the barge. These blocks serve as sinkers. Rows of concrete blocks spaced from 6 to 10 ft. apart are cast in place on the brush mattress as weights to hold it down. The size of the latter is varied with the buoyancy of the brush and force of the current, but is usually about 3 ft. square and 6 in. thick. A turn, or knot, of the cable on which they are cast is embedded in the form before the concrete is set. These weights are placed in transverse rows, and the rows are tied together longitudinally by cables running along both upper and lower selvages.

Above the water line the mattress is woven on the ground, which has first been prepared by grading to a uniform slope. When the water's edge is reached the

about \$16 per cubic yard. The cost of these concrete blocks ranges from \$10 to \$16 per cubic yard and is influenced largely by the size of the blocks and the delivery charges on materials.

The total cost of the brush revetment when weighted with concrete is usually from 9 to 11 cents per square foot. This varies with the size of job and nearness of construction materials. The amount of grading required on the levee slopes may increase the cost considerably, but under normal conditions and for a slope width of about 70 ft. the cost has been found to range from \$6 to \$10 per linear foot. Where fascines have been held in place by stakes, and no weights used, costs have been as low as \$1 to \$3 per linear foot.

MATTRESSES THICKENED ALONG TIDAL ZONE

Mattresses made of fascines are often thickened along the tidal zone to forestall the slipping or washing down of sand that sifts into and through the brush. On clay or alluvial soil this precaution is unnecessary. In some instances mattresses of this type have been floated into place and suspended as a temporary measure, particularly above broken masonry structures or in repairing breaks. At best, however, this brush protection is considered a semi-temporary measure. It is usual for the state to assess half the cost of the work on adjacent land-owners and allow half to be borne by the state. Where the brush mattresses are alternately wet and dry they decay rapidly.



GOOD PROTECTION FROM STEAMER WASH IN SHALLOW WATER, BUT SUBJECTED TO SERIOUS DAMAGE WHEN STRUCK BY BOATS

At most points along the lower Sacramento it is difficult to start a brush growth much above the water level because of the hot-weather effect in drying out the sand embankments, but where there is sufficient moisture it has been possible to get a live mat by driving willow stakes in the spring of the year into a mattress laid as described. When this growth is well started it is customary to cut off the tops of the willows occasionally to prevent tall growth and induce a thick spread.

Fascines placed at right angles to the river were used to protect a mile of levee on a 2:1 slope in district 1001, where a very swift current had caused serious undermining. The fascines were placed in four tiers, the lowest of which extended below low-water line, where it was anchored with concrete blocks. The four tiers protected a slope width of 70 ft., were securely interlaced with $\frac{3}{4}$ to 1 $\frac{1}{4}$ -in. steel cables, and were fastened to concrete deadmen and patent screw anchors at the top. Owing to the fact that the cables were bought second-hand practically at junk prices the cost of this work was only 3.8 cents per square foot, or \$2.65 per linear foot.

PILING WITH FASCINE FILLING

Bank protection consisting of a single line of piling with a backing of fascines has been used in various forms on the Sacramento River. The piles are usually driven 15 ft. into the river bottom, spaced 10 ft. apart. One or two feet on the inshore side a 4 x 4-in. redwood post is driven a foot or two into the river bottom and cut off with its top on a level with the top of the pile. Between the 4 x 4 and the piles a filling of fascines in single thickness is placed and wired to the piles.

This protection is not generally used where the depth is more than 10 or 15 ft. at low water, but it is considered an effective protection from the wash of steamers at low stages of the river. It has been used extensively below Sacramento, where the bank caving is due chiefly to the waves caused by the frequently passing vessels. It is, however, subject to serious damage when struck by boats or barges in tow, which break off the piles. Also, where bank caving is caused by current erosion during flood stages and by seepage water returning into the river after it has fallen rapidly, this type of protection is not the most effective.

The cost of this work in place ranges from \$2.75 to \$3.50 per linear foot. During the last four years Hav-

iland & Tibbetts, civil engineers, have installed for West Sacramento about 1 $\frac{1}{2}$ miles of this type of bank protection, the original design of which was developed by P. N. Ashley of Woodland, Cal. The average cost of this work was \$2.75 per linear foot. A length of about a mile of similar revetment was built for two reclamation districts above Sacramento at an average cost of \$3.50 per linear foot.

FASCINE FILLING TO REPAIR LEVEE BREAKS

Piling with fascine filling is often used on the Sacramento River for repairing breaks in levees. An example of this is the work on Sherman Island, where four rows of piles were driven across the break along the line of the old levee. The two inner rows of piling were 20 ft. apart and the two outer rows 26 ft. apart. The outer rows were staggered and fascines were crowded down in the 3-ft. space between them. When the current had been very largely reduced by this means hydraulic sluicing methods were used to fill the 20-ft. core between the two fascine facings.

This work was carried out where the depth was from 25 to 30 ft. and the tidal currents very strong. It is noteworthy that it was necessary to brace the piles transversely to prevent vibration and "popping out."

When bids were first called for on this work the lowest offer was \$43,000, but the plan just described proved effective and the work was completed within two months at a cost of about \$18,000.

WEDGE-SHAPED DEFLECTORS

A type of bank protection known as the Dean deflector has been used at various points along the river. On reclamation district 1001 this type of structure was built to safeguard about two miles of embankment. As first constructed the structure did not withstand the flood stages, but a similar type built according to a much improved design is asserted to have withstood the high water of 1915-16 and to have satisfactorily built up sand deposits along the bank below.

The deflectors are used to deflect strong cross-currents, and are made wedge-shaped with a nose angle of about 35 deg. The frame is built up of 6 x 8-in. timbers, firmly cross-braced and sheathed with 2 x 6-in. facing. The nose is weighted down with a block of concrete containing about 2 cu. yd., hung on cables from



FLEXIBLE CONCRETE MATTRESS BUILT OF PRECAST UNITS
A solid nose wall is an important feature of this type



EFFECT OF WAVE ACTION ON UNPROTECTED LEVEE
Water level still 5 ft. above levee base. Note slope and height.

the apex of the nose. Tie cables run from the nose to the bank along both upstream and downstream faces.

In order to allow the current to continue under the nose, only every third or fourth supporting post is extended to the bottom. Thus the current is checked somewhat but is not turned abruptly, as would be the case with a pile jetty. Hardly any eddy is formed on the downstream side of the deflectors, but a slight upstream current tends to cause deposition here of material in suspension. The deflectors are anchored into the bank by firmly driving the vertical 2 x 6-in. supporting posts and filling in the space between with brush and sand. They are usually spaced about 150 or 200 ft. apart and cost about \$350 apiece for single-deck structures, 14 ft. high at the nose and 60 ft. long on top.

SLOPES PAVED WITH CONCRETE

Some concrete paving has been used for slope protection where the cost of such work could be afforded. Typical of the successful construction of this type is the concrete paving about 15 miles south of Sacramento in district 307, on the back levee of the Lisbon district. On this work about 700,000 sq. ft. was paved. The slope was first trimmed to about 2:1 or 3:1 without any effort at careful grading, and was then rolled after being thoroughly watered. The roller was drawn up the slope by means of an electric crab operating from the top of the levee. Before the concrete was poured the surface was hard and rough, the latter quality being encouraged as a desirable element in a sloping concrete foundation.

About half way up the slope a triangular trench 5 in. deep, with its lower side perpendicular to the slope, was carried the entire length of the paving to serve as a lug to prevent slipping. There were no longitudinal expansion joints, because the paving was only about 60 ft. wide, but an expansion joint running up and down the slope was placed every 60 ft. This joint was formed by terminating one slab in a depressed shoulder, which afforded a support at slope level upon which the edge of the adjacent slab could rest and move freely, tar paper being used to prevent bond between the shoulder and the next slab, which was afterward poured upon it. Where the slabs abutted a 1/2-in. space was left between them. The bottom of the slope at tidewater level terminated in a row of 2-in. redwood sheet piling.

The paving is 4 in. thick, reinforced with 6 x 6-in.

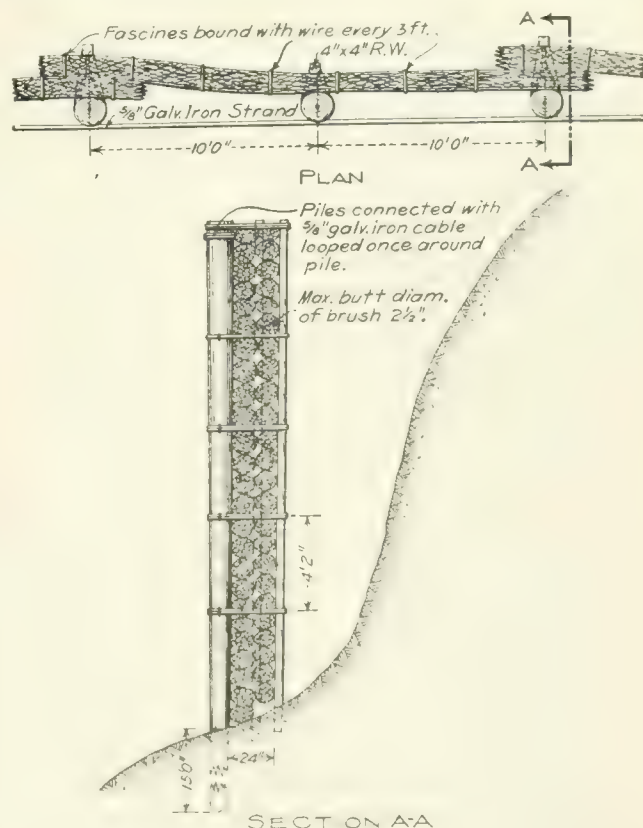
No. 10 wire mesh, the reinforcement being kept as near the center of the slab as possible. The finish was rough, no attempt being made to use the trowel. The cost of this work was about 12 cents per square foot, or \$7.20 per linear foot, including grubbing and rolling. Since this paving was placed six years ago no movement or breakage has occurred, it is reported, although there were many breaks in the levee previous to that time. This work was designed and constructed under the supervision of P. N. Ashley.

It is significant that the dike referred to had been in service 8 or 10 years before the paving was laid. Paving built under similar specifications on a comparatively new levee failed during the first winter because of settlement in the foundation. The best practice is therefore to pave only well-settled embankments.

REINFORCED CONCRETE IN STRIPS

On the Yolo Basin side of the West Sacramento project reinforced-concrete levee facing was placed on a portion of the clay levees as a protection against waves during heavy storms. The concrete was laid in strips from 16 to 20 ft. wide and 3 to 5 in. thick, reinforced with light wire mesh. The maximum slope is about 2:1. In some of this work the toe terminates in sheet piles from 3 to 5 ft. long or in the concrete cutoff wall extending down into the berm. At the upper edge the slope rises up on the crown of the levee, but terminates in a parapet. The cost of this paving was about 12 cents per square foot.

A type of articulated pavement consisting of precast concrete slabs small enough to be conveniently handled was used for protecting a stretch of the levee just below Sacramento. The slabs were cast with pairs of cable



BANK PROTECTION LIKE THIS COSTS FROM \$2.75 TO \$3.50
PER LINEAR FOOT

tie wires extending from each corner, and these were used to tie the blocks to the anchor cables. This revetment requires a toe wall if not founded on a firm bank of flat gradient. In a length of about $1\frac{1}{2}$ miles of this articulated revetment the cost, including about 1000 ft. of toe wall, was \$10.62 per linear foot, or about 21 cents per square foot.

NARROW CHANNEL IMPORTANT ELEMENT

Embankment protection which can be considered fairly permanent, including the most substantial weighted brush mattresses, may be figured to cost, roughly, \$10 per linear foot. This figure added to the original cost of dike or levee is more than is warranted by the value of the lowland to be protected except for short stretches where there is special danger, or where city property is involved. Because the channel is comparatively narrow at low water the steamer wash below the city of Sacramento, where the river traffic is heavy,

DREDGE TYPE PRODUCED TO BUILD LEVEES WITHOUT REVETMENT—THIS MACHINE, THE "MARS," HAS A BOOM 230 FEET LONG AND OPERATES A GRAB BUCKET WITH A CAPACITY OF $6\frac{1}{4}$ CUBIC YARDS



becomes an important element in accelerating bank caving. The great weight of high levees close to the banks accentuates this difficulty.

The conclusion of engineers engaged in flood-protection work is that there has not yet been developed any economical type of levee revetment well suited to the requirements. As a result, the practice in many cases has been not to use any protection whatever for the river slope of the levee, but to set it back from the river channel as far as it could conveniently be located and then slope the river bank gradually up to the levee base. This requirement has resulted in the development of dredges with extremely long booms. One of these, the dredge "Mars," operates a $6\frac{1}{4}$ -yd. grab bucket on a 230-ft. boom.

OBJECTIONS TO SETTING LEVEE BACK

The objections to setting the levee back are that the highest ground is usually very close to the bank of the low-water channel, and there is always the objection of landowners to giving up a strip along the river wider than the absolute minimum. Another difficulty in keeping the revetment cost low is that there is a 30-ft. variation in stream height at Sacramento. This means a 67-ft. width of slope even where the steepest grade of 2:1 is used, if full-width protection is to be provided. These considerations are leading to experiment with further revetment schemes, and it is still hoped that there will be developed a design which will afford the necessary degree of protection without prohibitive cost.

Cave Over Mine Complicates City's Sewerage Problem

**Flume on Jacks Will Carry Storm and Mine Water
—Disposal Plant Not Recommended, as
Only a Clean Creek Bed Is Needed**

SELDOM does a town of less than 10,000 inhabitants have the multiplicity of sewerage problems that confront the mining town of Iron Mountain, Mich. Caving ground over the Chapin mine across a valley down which the natural drainage formerly flowed and into which backed-up storm water now finds its way only to be repumped after seeping down 1400 ft. into the mine workings are the causes of much of the difficulty. Last October Alvord & Burdick made an exhaustive examination, and some of the more vital points are taken from their report.

In the first place the town is not growing and prob-

ably will not grow to any extent for a generation, because the timber industry has passed and the mining interests, while working at full capacity, are employing less men now than they did twenty years ago. Although spread out over an unusually extensive area, the present sewerage facilities were found adequate insofar as the sewers now reach the various parts of the city. Of four projects to carry away the sewage which originates in the main portion of the city up the valley from the cave, the cheapest was to bridge the 850 ft. of caving ground with a wood flume supported on jacks. The three other methods involved pumping over a hill or laying sewers in deep cuts across a saddle back of the town.

A 24-in. steel pipe now carrying domestic sewage, storm water and 5,000,000 gal. of mine water over the cave is to be retained for the domestic sewage only.

A shallow lake in the lower part of the town has been maintained under agreement at a constant level by diverting a portion of the diluted sewage flow. As the lake is used extensively for bathing purposes, the separate-system idea will permit only mine waste and storm flow to go to the lake, while the domestic sewage will continue down the valley to the outfall creek.

The withdrawal of the mine water from the 24-in. steel pipe may cause some trouble on account of freezing. If that is found to be the case it will be practicable during the winter to turn the warm mine water back into the steel pipe temporarily.

The relative advantages and disadvantages of separ-

ate versus combined sewers, as set forth in the report, are given below, for they are applicable generally. Among the conditions favorable to a separate system are these:

1. Where storm water does not require extensive underground removal, or where it can be concentrated in a few shallow underground channels.

2. Where drainage areas are short and steep, facilitating rapid flow of the water over street surfaces to the natural watercourses, but without erosion of the street surface.

3. Where the sanitary sewage must be pumped and the additional cost of pumping even a small amount of storm water is great. In this case especially is it true that if the overflow of storm water into a watercourse is not permissible, the separate system has great advantages.

4. Where the sanitary sewage must be purified and storm water in a combined sewer either purified or bypassed—either scheme requiring large purification plant capacity or creating nuisance due to the overflow of objectionable refuse.

5. Where the sewers are being built in advance of the city's development to encourage growth, the sanitary system provides a maximum of miles of sewers for a minimum of expenditure. The storm sewers, if ever required, may be built later, and rarely need cover over about one-half the area covered by a sanitary system.

6. Where an existing sewer is laid at grades unsuited to receive sanitary sewage, it may frequently be used as a storm sewer.

7. A combined system must usually be relatively of larger capacity than a separate storm drain for the same area, and the reason for this is that a storm drain may be overloaded at long intervals with slight inconvenience, whereas, on account of basement connections and the sewage carried by a combined sewer, any overflow is accompanied by great nuisance and complaint.

WHERE COMBINED SYSTEMS ARE DESIRABLE

The conditions favorable to the combined system are:

1. Where both storm-water sewers and sanitary sewers must be fully and completely installed throughout a district, the cost of complete storm drains and separate sewers in each street is greater than the cost of one combined sewer.

2. Where no pumping or purification of the sewage is required at present or anticipated for a reasonable length of time in the future.

The topography of Iron Mountain is such that the storm-water flow can be conducted underground through pipes following the original drainage lines, and therefore in shallow trenches. The slopes are so steep that main sewers only are needed for storm-water carriers if the separate system is used, while if combined sewers are used sewers of relatively large size will have to be laid in all streets where sanitary sewers are necessary. Great economies can be secured by the adoption of separate sewer systems for storm and sanitary flow, as well as a minimum of nuisance in the small outfall creek due to the frequent discharge of storm water in amount which exceeds the capacity of the outfall creek.

A comparison of four types of conduit across the cave included a 54-in. riveted steel pipe, a galvanized-iron

flume, a 54-in. woodstave pipe and the 48 x 54-in. wood-box flume recommended. The table shows the result of the comparison—maintenance and repairs being assumed equal.

The useful life of the flume compared with that of the woodstave pipe was estimated longer because of the creosote treatment. The flume would be open at the top,

COMPARATIVE TABLE OF FOUR TYPES OF CONDUIT

Type crossing	Estimated first cost	Life, years	ESTIMATED ANNUAL COSTS		Total
			Interest at 5 per cent	Replacement charge	
Steel pipe	\$17,600	35	\$850	\$485	\$1,335
Steel flume	2,750	15	137	183	320
Woodstave pipe ...	3,600	10	180	360	540
Wood flume box...	2,000	20	100	100	200

and it would be banded with 4 x 4-in. timbers and rest on 4 x 10-in. timber stringers. The section would weigh about 175 lb. per foot. The bents would be placed 16 ft. apart and the 6 x 10-in. base plates would be supported by two 10-ton jacks, which would rest on a 6 x 12-in. mudsill.

OUTFALL NUISANCE EASILY REMEDIED

No disposal works were recommended for at least a generation. The dilution ratio of mine water alone to sewage is 1 to 10. Some time ago the city purchased a 100-ft. strip 2 miles long to the Menominee River on each side of the creek. This strip practically occupies the entire valley in which the creek lies. The storm water causes the nuisance because the cross-section, obstructed by vegetation, is insufficient. In consequence the water and sewage overflows the banks, depositing materials which later on give off odors.

Enlargement of the creek cross-section at a cost of \$3,000, as against a \$54,250 disposal plant, outright purchase of two adjoining farms or a \$30,000 outfall sewer to the river is the proposed simple solution of the nuisance problem, with maintenance consisting only of the removal of the vegetable matter from the creek bed at least once a year.

The examinations were made on the ground for Alvord & Burdick by L. R. Howson, principal assistant engineer.

Alkali Brooms Poles and Posts

In alkali regions on the Uncompahgre reclamation project in Colorado a peculiar brooming of poles and posts takes place at the ground surface, due to the expansive action of alkali. The project manager in the December *Reclamation Record* states that the water is at or very near the ground surface where the brooming is noticed. A heavy coating of alkali is always visible. A telephone pole of Western cedar brooms to twice its natural size and so do fence posts of native cedar. A notable exception are posts of peeled cottonwood. An examination of the fence posts brought out the fact that cedar is more susceptible to alkali action than either pinon or cottonwood. The explanation is undoubtedly to be found in the relative porosity of the woods. It is evident that in the treatment of poles or timbers or porous wood exposed alternately to saturation and crystallization of alkali salts a waterproof coating is necessary.

Reinforced Concrete Successful for Railroad Culverts

Costs Less Than Cast Iron and Is More Durable in Acid Waters—Lengths, Types of Joints, Section and Reinforcement Discussed

By JOSEPH S. LAMBIE

Assistant Professor of Civil Engineering, University of Pittsburgh, Pittsburgh

FOR many years cast-iron pipe has been the favorite material for railroad culvert service. Though still used extensively by some of the more conservative roads, it is fast being replaced by reinforced concrete where materials for its manufacture are readily obtainable. This change is due principally to the considerably smaller cost of the latter type of construction, and in localities where sulphur or acid waters are prevalent to the non-corrosive qualities of the concrete.

BOX AND PIPE CULVERTS

Concrete culverts are of two distinct types—box culverts and pipe culverts. The former are constructed in place, usually according to designs prepared by the railroad, and are monolithic in character. The labor involved in their construction and the time necessary for their curing are features which make their use often undesirable. Pipe culverts are made in sectional lengths, varying in diameter from 12 in. to 8 ft. They may be made either on the ground at the point of erection or shipped, ready cured, from some central factory. Owing to better facilities for making and handling, the factory-made product is usually the better pipe. Some idea of the economy of the latter type of construction can be obtained from the accompanying table, which lists the various sizes, weights and prices of cast-iron and reinforced-concrete pipe.

TWO GRADES OF CONCRETE PIPE

Concrete pipe is made in two grades, the heavier being intended for service under track, while the lighter is used for longitudinal drains at grade crossings, or at any other point not directly beneath the track. No broad specifications have as yet been generally adopted leading to uniformity in the manufacture of this product, consequently considerable variation in the standards for length, type of joint, section and reinforcing of different manufacturers are noticeable.

Unit lengths on concrete pipe vary from 4 to 8 ft., as compared with 12 ft. for cast iron. It is claimed for the shorter lengths that they are easier to handle, will

combine readily to form a culvert of any length, and are of particular advantage for maintenance work under a multiple-track roadbed, as they can be lowered between adjacent tracks without displacing the ties or interrupting the service.

Several types of joints are furnished by different manufacturers, with the common "bell and spigot" predominating. So-called "lock joints" are made with a variety of detail, the lock feature being obtained by the overlapping of the reinforcing for an inch or two at the joint, or by the filling of a groove in the joint with mortar. It is doubtful if these are of sufficient bonding or shearing strength to be very effective, and as this type of joint is usually of the "shiplap" character it is not of equal transverse strength with the body of the pipe.

The thickness of the shell and the shape of the section will vary with the amount and position of the re-



FIG 1 FIG 2 FIG 3 FIG 4
FOUR VARIATIONS IN CONCRETE-PIPE REINFORCEMENT

inforcing used. The illustration shows four general variations of these factors. The type shown in Fig. 1 is satisfactory for small sizes—12 to 18 in. in diameter—where the thickness of the shell is in excess of the thickness necessary to support the loads carried. The steel should be placed at the center of the shell. For pipe more than 18 in. in diameter, to obtain the greatest possible effectiveness of steel and concrete, two rings of reinforcing should be used—one placed near the inner and the other near the outer surface of the shell, as shown in Fig. 2. If it is possible to determine accurately the direction of the load thrust upon the pipe, a large economy of steel can be obtained by using only a single ring, as shown in Figs. 3 and 4. Since it is difficult to hold an elastic ring of steel in any shape other than a true circle, the latter of these two types is more commonly used—the steel being circular and the concrete section sufficiently elliptical in shape to produce the desired transfer of the reinforcing from the inside to the outside of the shell.

The position of the reinforcing, as shown in these latter figures, is correct for a theoretically vertical load. Any material variation of the line of thrust from the

COMPARISON OF COSTS OF STANDARD CAST-IRON AND REINFORCED-CONCRETE CULVERT PIPE

Inside Diameter.	CAST IRON				REINFORCED CONCRETE			
	CLASS A, LIGHT	CLASS B, MEDIUM	CLASS C, STANDARD	CLASS D, EXTRA HEAVY	HEAVY	LIGHT	HEAVY	LIGHT
	Weight	Price	Weight	Price	Weight	Price	Weight	Price
12	72.5	\$1.37	82.1	\$1.56	91.7	\$1.74	100.0	\$0.70
14	100.0	1.90	113.7	2.16	130.0	2.47	144.0	.90
18	129.2	2.45	150.0	2.85	175.0	3.31	191.7	1.10
24	204.2	3.87	233.3	4.43	279.2	5.31	306.7	1.50
30	291.7	5.52	333.3	6.33	400.0	7.60	440.0	1.90
36	391.7	7.43	454.2	8.61	545.8	10.37	625.0	2.45
42	511.7	9.74	591.7	11.22	716.7	13.61	825.0	3.05
48	656.7	12.67	750.0	14.25	908.3	17.25	1050.0	3.75
54	826.0	15.20	933.3	17.70	1141.7	21.68	1341.7	4.60
60	1017.7	17.40	1104.2	19.88	1341.7	25.50	1583.3	5.15
66	1100.0	20.90	1325.0	24.18	1623.0	30.85	1800.0	5.85
72	1283.0	24.40	1548.8	29.43	1904.2	36.18	2100.0	6.65

*The weight of cast-iron pipe not made—prices on them are approximated simply as a comparison. Cast-iron weights shown above adopted as standard by American Waterworks Association, May 12, 1908. Cast-iron prices based on current quotations of \$28 per net ton, November, 1916. Reinforced-concrete weights and prices averaged from manufacturers' standards.

vertical will greatly reduce the effectiveness of the reinforcing. Should the thrust become horizontal, or the pipe inadvertently be placed with its major axis horizontal under a vertical load, the pipe would develop but slightly greater strength than plain concrete. It is evident that the proper placing of pipe reinforced in this manner is a problem of some nicety and not at all fool-proof. An additional disadvantage of the type illustrated in Fig. 4 is the fact that its shape will not permit of its use in extending existing culverts of cast iron or any pipe of circular section.

THICKNESS OF SHELL

Concrete pipe having a shell three times as thick as a cast-iron pipe of the same nominal diameter, or having the same weight per linear foot, is capable of supporting the same loads if properly made and reinforced. About 0.8 per cent of tensile reinforcing is the proper amount to produce a reasonable relation of stress in steel and concrete for pipes having this thickness. The reinforcing steel may consist of rods forming separate rings, some type of mesh, or continuous spirals. In the first two cases sufficient lap must be allowed to insure the steel taking full stress at any point. In any case the distribution of the metal throughout the length of the pipe should be unusually thorough, due to the vibratory character of the loads. The exact amount of the reinforcing will of course depend upon the thickness of the shell, and vary inversely with it; the more recent, and probably more logical, tendencies point toward the use of thinner shells and more reinforcing.

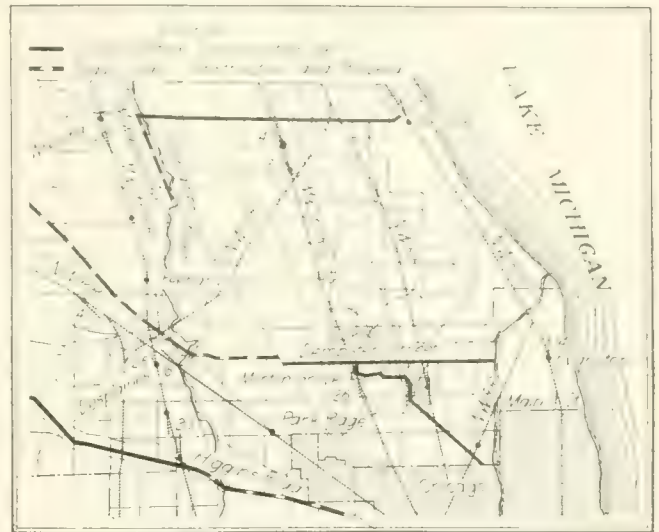
Prepares Maps to Help Road Contractors in Bidding

Cook County (Illinois) Highway Department Shows Sources of Materials, Condition of Roads and Other Useful Data

IN PREPARING to let contracts for \$1,000,000 worth of highways in Cook County, Illinois, the county highway department has taken unusual care to give the bidders every scrap of information that would help them figure on the job. In addition to the usual data and specifications, two maps have been prepared. One shows the bidders the location of all sand, gravel and stone supplies within a reasonable distance of the various sections. Each of these material bases has been inspected, so that the contractor is assured that acceptable material can be obtained from them. This does not mean that there may not be other plants, but the list is thought to be as complete as it is economically feasible to make it.

PRESENT ROAD CONDITIONS

On a second map which is to be furnished to the contractors taking out plans are shown all sections of roads to be built this year and all now under construction and closed to traffic. All railroad sidings are marked with a figure indicating the number of cars that can be accommodated. This information was furnished by the railroads, many of which stated that extensions would be provided if necessary. The maps also show the boundaries of all municipalities. Some of the towns have traffic regulations which may preclude



RAILROAD SIDINGS AND CONDITION OF ROAD SHOWN BY NUMBERS

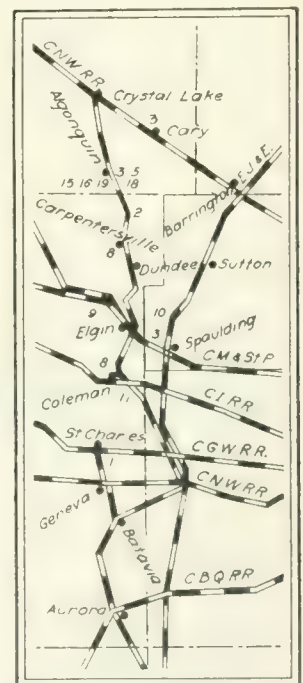
the use of heavy motor trucks without special permits. Camping privileges and other arrangements for housing the men may be effected in some cases.

As noted in the Engineering Record of Jan. 20, alternate bids will be taken for concrete of an average thickness of 7 in. and for asphaltic concrete 2 in. thick on a 6-in. macadam base, or on a 5-in. base of 1:3:5 concrete. Cuts and fills have been balanced each 1000 ft. Asphaltic concrete roads must be maintained for one year.

Higgins Road, 19 miles long, divided into two sections, will be one of the longest stretches of hard pavement under construction in the state. Six miles was let last year. The road will provide an outlet from the Chicago city limits to the county line. With $3\frac{1}{2}$ miles of road under construction between the southern county boundary and the city limits, and $\frac{1}{2}$ mile still to be done in Milwaukee Avenue on the north, there will be a paved highway of 60 miles north and south before the close of the season.

The smaller drawing is a reproduction of a part of the map showing the location of material bases. The other sketch was taken from the map showing the road now under construction and that to be built and indicating the location and capacity of railroad sidings. These two parts of the map show the value of the information to the contractor.

The first contract, to be let the first week in February, will be followed by lettings every other week. George A. Quinlan, 325 Court House, Chicago, is the county highway superintendent.



SOURCES OF ROAD MATERIALS AND NAMES OF COMPANIES INDICATED

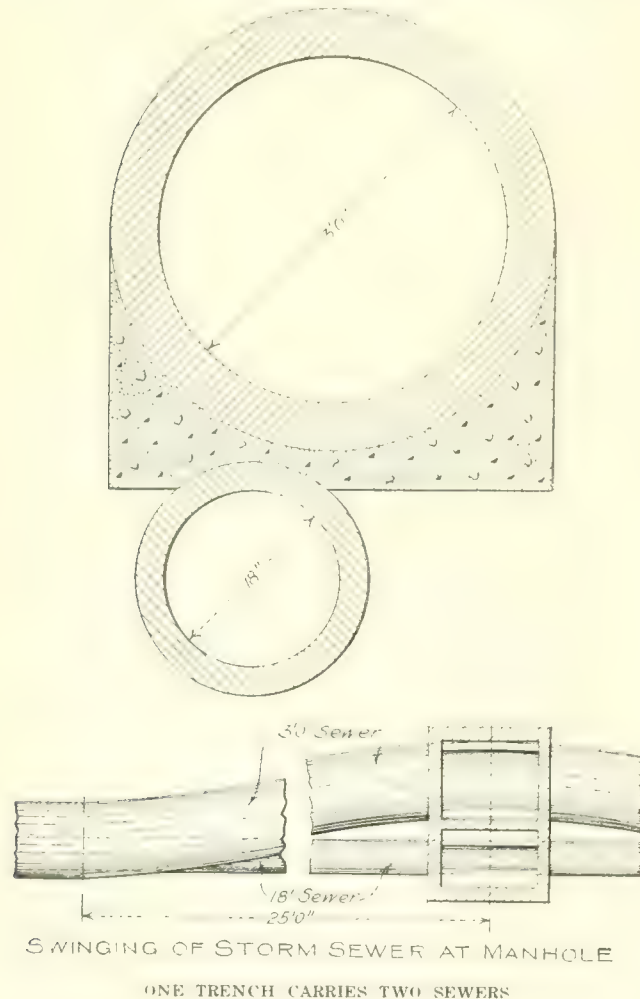
Two Sewers Laid in One Trench

Storm-Water Drain Placed on Top of Sewer and Offset to Allow for Combined Manhole Construction

By MANLEY OSGOOD

Consulting Engineer, Ann Arbor, Mich.

THE drawings show what I consider rather an unusual sewer design. In order to drain a low point in the city of Ann Arbor it became necessary to lay both the storm-water and sanitary sewers through a 28-ft. cut. The nature of the soil made tunneling impossi-



ble, and it was decided to lay both sewers in the same trench. The sanitary sewer is laid at the bottom and to one side of the trench, with the larger storm sewer on the top of it.

Approaching manholes, the storm sewer, which was large enough for a man to go through, was swung, as shown, in a manner to allow the construction of combined manholes with a division wall between the storm and sanitary sewers. The smaller sanitary sewer was constructed perfectly straight to permit cleaning.

The storm sewer was made of American Sewer Pipe Company's segmental block, which, for proper construction, requires very rigid support on the under side up to the springing line. Inasmuch as the bottom of the trench was necessarily disturbed to permit the construction of the sanitary sewer, a concrete cradle was placed below the storm sewer through the deep cut.

Build Philippine Roads in Seven Years at Half Estimated Cost

Time Allowed to Complete System Was 17 Years—
Actual Cost \$18,500,000—Saving Due
to Efficient Organization

BECAUSE of the cordial response of the Filipino people to the propaganda for good roads, elaborate projects and various types and widths of road were eliminated, and because of highly efficient methods and organization, rapid advances have been made in highway work in the Philippine Islands. The original time estimate for the construction of highways provided by legislature enacted in 1908 was 17.2 years; the system has been practically completed in 7 years. The estimated cost of the work was \$37,250,000; only \$18,500,000 has actually been spent. Therefore the work has been accomplished in about 41 per cent of the allowed time at a cost not exceeding 50 per cent of the original estimate. In 1909 it was estimated that 5710 miles of road was necessary. There was in existence on Jan. 1, 1916, 5085 miles of highway, according to the annual report of the Philippine Commission, recently issued.

MOTOR TRUCKS HASTEN ROAD WORK

Motor trucks have had their effect in the Philippine Islands as elsewhere. These vehicles are one of the factors which have greatly accelerated the progress of the road work in the last seven years. This kind of traffic has also increased the needs for good roads far beyond those of seven years ago. The opening of many new sources of supply of stone and the development of reinforced-concrete bridge work, while reducing construction and maintenance costs, have also operated to develop a great demand for similar work in territory unopened by the Spanish administration. While the road system, as it is to-day, fills the greater requirements of 1909, the need for new and better roads has grown with the development of the country.

Because it was feared that recent road building in the Philippine Islands was not justified by the traffic and that the maintenance would become burdensome, certain road policies were adopted in 1908 and have been strictly adhered to. One of these is that road and bridge construction work must be justified by traffic not only in existence but which is also productive. Projects whose only merit was the development of the country were not considered. Another requirement is that road-construction projects should be started only when funds were assured for their maintenance.

SITUATION ANALYZED BEFORE ROADS WERE BUILT

To insure the application of these principles a form of indorsement accompanied the estimate of cost of road projects. Among the questions considered were those of population, amount of traffic as shown by actual count, the products of the country traversed, the interest and the funds invested in the construction, and the cost of maintenance.

That the good-roads system is not burdensome to the country is shown by the regular adoption, twice a year for many years, of resolutions insuring the maintenance of first-class roads under the system specified by

the insular government. Other proof of this is that the annual provincial road and bridge fund exceeds the amount required for maintenance by more than \$500,000. Allowing an average annual maintenance charge of \$403 per mile, it is estimated that the provinces can maintain not less than 520 additional miles of first-class road without allowing for natural growth in wealth and population and disregarding the increase in the road and bridge fund which will follow upon the reassessment of land.

Columbus Has New Crystal or Cake Alum Plant

Bauxite and Sulphuric Acid Alone Are Mixed and Then Allowed to Cake—No Boiling Tanks Are Necessary

RADICAL simplification of the home-made alum outfit at the water-purification plant at Columbus, Ohio, is indicated in one of the photographs herewith, which shows the old liquid-alum plant and the new crystal or cake-alum apparatus. Comparing this photograph with the one appearing in the Engineering Record May 8, 1915, page 576, describing the syrup-alum plant, it will be observed that the sludge tank at the left, provided in the original plant, has been removed and a platform built over the space occupied by the sludge tank. On this platform is located the mixing pan for making crystallized alum. Underneath it is the crystallizing pit. Bauxite is weighed out in the original weighing hopper over the alum boiling tanks. Acid is measured in the acid weigh box, which is also a part of the old plant. Definite amounts of bauxite and acid are discharged into the iron mixing pan and stirred for five minutes. Through a plug valve in the bottom of the pan the mixture flows into the pit, where it boils for a short time and then is crystallized.

The large lead-lined boiling tanks, with their complement of steam coils, are eliminated. This is made possible because no water is added to the mixture.

Bauxite and acid are stirred together, the acid alone acting as the solvent. Considerably less acid is used than is chemically equivalent to the alumina bases present; thus there is no wasted acid, and the resultant cake is highly basic, from 10 to 14 per cent of the alumina content being basic. Since it is less stable than the acid-combined alumina, it dissociates quickly, producing rapid coagulation, large flocs, and quick sedimentation.

Cake alum made by the simplified process has all the advantages of the syrup for cold and clear waters, in that it has all the impurities which act as nuclei around which coagulation starts. In addition, the process is shortened, and the product can be handled and shipped with greater facility.

The Columbus plant was put into operation by Charles P. Hoover, chemist in charge, and the inventor of the process, prior to the installation of the elaborate iron-alum plant at Omaha, described in the Engineering Record of Oct. 7, 1916, page 435. At Columbus it is the custom to make up the cake one day and take it out of the pit in large slabs the following day.

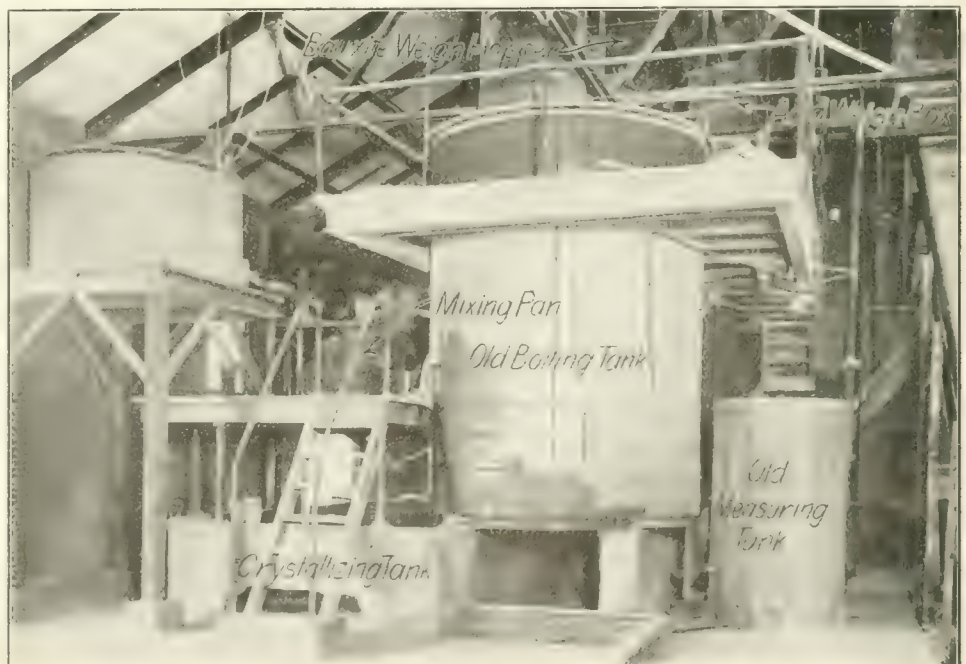
Find Value of n in Kutter's Formula for Metal Flumes

U. S. Reclamation Service engineers experimenting on metal flumes of the North Platte and Uncompahgre Valley projects report that 0.012 is a fair average value for n in Kutter's formula for smooth interiors, and that 0.013 may be considered amply safe for design. Much higher values of n for flumes with protruding joints were noted, the average from the few experiments made on this type being 0.0185. Six experiments on No. 120 flume made on the Uncompahgre project in former years gave an average value of 0.0207. These previous experiments are of somewhat doubtful accuracy, but may properly be used to add weight to a cautionary statement that it is not safe to use a value of n much smaller than 0.020 when computing the capacity of a flume of the protruding-joint type.



ALUM CRYSTALLIZES IN PITS IN 3 TO 4-INCH LAYERS

RIGHT — CRYSTALLIZED ALUM PLANT ELIMINATES BOILING TANKS



Makes an Analysis of California's Water Problems

Data on Many Phases of the Use and Administration of Water Rights Collected by Water Problems Conference

AFTER spending a year investigating the subjects under its jurisdiction the State Water Problems Conference of California has published a 125-page report which presents an exhaustive analysis of present conditions and recommends a policy and procedure to the 1917 legislature. The conference automatically dissolved upon the completion of its work, but the various interests concerned with irrigation, reclamation and power development in the state are taking the report as a basis upon which to make urgent demands for action upon the legislature now in session.

The conference was created by a legislative act in 1915 with the lieutenant-governor as chairman and sixteen other members, including the chairmen of all state commissions involved and six representatives at large appointed by the governor. Instructions to the conference were to "recommend a unified policy with reference to irrigation, reclamation, water storage, flood control, municipalities and drainage, with due regard to the needs of water power, mining and navigation." The opening session of the conference was reported in the Engineering Record of Nov. 27, 1915, page 676.

PRELIMINARY ANNOUNCEMENT OF FINDINGS

In the preliminary announcement published with the "Findings and Recommendations" of the conference, after emphasizing the value of water resources in California, it was stated:

"That these water resources are to a great extent undeveloped, and that existing conditions do not lend themselves readily to development.

"That the problems involved in the development of these resources are greater in number and greater in magnitude than those which confront any other state in the Union, and that they are yet, to a considerable extent, unsolved.

"That these problems will remain unsolved and these resources to a great extent undeveloped until the state has established a definite policy with regard thereto and created authority with special powers to work out the problems and to direct the various matters having to do with the uses of water.

"That the state is not now in position to itself develop these resources, and, if they are not to be permitted to remain indefinitely in disuse, a source of great economic waste and a bar to progress, the state should so define her policies and frame the legislation necessary to carry them into effect as to secure the largest amount of active co-operation on the part of private capital and interested landowners, under conditions which properly safeguard state interest."

OVERDEVELOPMENT OF HYDROELECTRIC POWER

Data were placed before the conference indicating an overdevelopment of hydroelectric power for ordinary purposes in California, and showing that the real demand is for more markets rather than for more power. The conference found that the use of electricity per

capita in California exceeds that of any other state, and that the purposes for which it is used are more varied, while the average rate per kilowatt-hour for all purposes is less. No proof, however, was found either that California is using all the electrical energy it can, or that energy cannot be furnished at a still lower rate. In the suggestions made by the conference, new uses for water power are indicated.

POLICY OF RAILROAD COMMISSION

The policy of the Railroad Commission in refusing to permit new power companies to enter territory already served is referred to as "fraught with one apparent disadvantage." Since rates are fixed on the basis of cost of service to the company, the installation and operation costs of plants put in years ago often lead to a service charge greatly in excess of that which would be sufficient to cover the costs with a modern plant using the same source of energy.

"While the old plant of the established company may have been displaced in large part by a modern one, its cost is still represented by bonds and stock on which interest is allowed by the commission, and paid in rates by the consumer. Theoretically the public should have the advantage in rates justified by latest methods and improved machinery. Undoubtedly the rates are in a number of cases considerably in excess of the rates which would return fair profit on a modern plant; but, on the other hand, they may not be higher than the rates which the consumer would ultimately pay if a competing company came into the field and in time absorbed or was absorbed by the old company. This probably is the reason for the commission's action."

RECOMMENDATIONS OF CONFERENCE

These are among the findings extracted from the report. The private development of natural resources must be encouraged and legislation should be directed toward securing the conservation and use of water power, at the same time safeguarding private rights and reserving to the state the privilege of assuming control upon payment of a fair consideration.

State authority in water matters should be vested in three state commissions, with jurisdiction so regulated as not to clash, and with powers similar to those enjoyed by the Railroad Commission. These might quite properly be (1) a state flood-control board, which would supersede the present State Reclamation Board, (2) the present State Irrigation Board, and (3) the present State Water Commission, the latter to have authority over all water matters not within the jurisdiction of the other two boards. A satisfactory solution of state water problems calls for "several years' work of these three boards even if composed of the ablest men to be found in the state."

TO MINIMIZE RIPARIAN-RIGHT EVILS

Recognizing that it is too late to abrogate the common-law doctrine of riparian rights, which under court decisions has become a property right, measures likely to minimize the existing evil are recommended as follows: "(a) A law empowering the court to determine the amount of damage sustained by a complaining riparian owner and the conditions under which the proposed interference with his riparian rights may continue; (b)

a law prohibiting the issue of an injunction on application of a riparian owner unless damage is shown, and (c) a law limiting the time within which a riparian owner may bring action to protect his rights to three months after notice of the work of which he complains."

The fixation of nitrogen, the smelting of iron and steel in the electric furnace, the manufacture of electrochemical products and the increase in the consumption of current for common uses offer possibilities to a state where the available hydroelectric power now being wasted would cost annually \$168,000,000 if produced by steam. Recommendation is therefore made that an investigation be made at once as to what extent and how the available power can be profitably utilized, that state policies in these matters be determined and that efforts be made to secure such modification of prohibitive or restrictive federal legislation as will encourage embarking of private capital in power plants while properly safeguarding public interest; and that the state, by encouragement and aid, foster such enterprises.

IRRIGATION SUPERIOR TO NAVIGATION

Irrigation is recognized as a superior beneficial use of water to navigation. It is recommended that if in the future it shall appear necessary to take out of a navigable stream for irrigation so much of its flow as to endanger navigation, then if such navigation be necessary in the state's interest for insuring profitable markets for the products of irrigation, navigation shall be maintained by canalization. Mining, too, is recognized as an inferior right which will have to yield to irrigation when the two conflict.

It is recommended that comprehensive plans for flood control and reclamation suited to the various sections be formulated and that the construction and administration of internal affairs be carried out by the various districts, the state authorities simply exercising general laws to secure efficient administration. A general plan of state aid in reclamation, irrigation and similar enterprises is recommended, the arrangement being such that the state's credit be extended to such projects as have been approved by the proper state authorities. This would save the loss of the 15 to 30 per cent discount now often necessary to the sale of such bonds, and at the same time delinquency measures could be provided to protect the state against non-payment of assessments.

TEMPORARY FINANCIAL AID

Pending passage of a constitutional amendment sanctioning state aid in such enterprises it is recommended that temporary relief be provided in the shape of a revolving fund of \$500,000, from which any coupon of an enterprise which has been approved by the proper state commission will be paid on demand. Protection for the state shall be secured by a provision permitting the state to take over administration of the enterprise when payments thus made exceed 15 per cent of the current interest due for one year.

The doctrine of prior appropriation should apply to underground waters so that he who first makes beneficial use of the water shall have the right to as much as is necessary for the purpose to which it is applied. Whenever it is practicable to care for flood waters by storage, co-operation among the various interests con-

cerned must be encouraged so that projects not economically justified for one interest alone may be carried out. It is recommended that the state exercise full control over the construction and maintenance of dams, with full power to prevent their use unless declared safe.

To reduce materially the great expense and delay involved in water litigation it is recommended:

(a) "That the findings of the three state water commissions be final as to all matters of fact.

(b) "That expert witnesses be no longer allowed to testify as such in behalf of either side; that a court expert be appointed when necessary, by agreement between the parties to the suit, or, if they cannot agree, then by the court; and that each side may cross-examine the expert as to matters concerning which he testifies.

(c) "That a superior judge be selected by the governor to try all water cases, in accordance with the principle already established in connection with trial of reclamation cases. Such a plan would greatly reduce the number and expense of Superior Court trials as necessitated by the present system, and would tend to free them from local influence and prejudice.

(d) "That procedure in the exercise of the right of eminent domain by a state agency be so changed as to avoid delays. . . . It is proposed to adopt the plan successfully followed in Mississippi and Arkansas, under which possession of the property is secured at once by payment of its valuation as fixed by the court. Subsequent proceedings are had to determine finally the value, and the necessary adjustment is made by payment of more money, or by return of a portion already paid, as the case may be."

TO UNIFY STATE POLICIES

It is recommended that in order to unify state policies the legislature submit to the three water commissions all bills pertaining to the use or control of water rights and that the commissions be required promptly to report back to the legislature. The conference believes unwise the policy which allows a municipality to tie up indefinitely unlimited quantities of water to meet anticipated needs of a remote future. It recommends instead that the State Water Commission be authorized to make reasonable provision for future development of municipalities.

October Railroad Income 8.7 Per Cent Better Than in October, 1915

Gross operating revenues for October, 1916, on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were \$1,466 per mile, showing an increase of \$143, or 10.8 per cent, as compared with October, 1915. Operating expenses were \$910, an increase of \$95, or 11.7 per cent. Net operating revenue therefore was \$556—an increase of \$48, or 9.4 per cent, and operating income was \$495, an increase of \$40, or 8.7 per cent. The operating ratio was 62.1 per cent, as compared with 61.6 per cent in October, 1915. Considering the three main districts, the respective ratios for October, 1916, and October, 1915, were as follows: Eastern, 66.9 and 63.4; Southern, 62.6 and 66.2; Western, 57.0 and 58.2.

Oregon Society of Engineers Wants Timely Discussions

News of Activities of the Society Secondary to Criticism of Articles with View of Developing New Ideas

BELIEVING that the journal of an engineering society should do more than record the activities of the organization, and that the official publication should be the clearing house of ideas and made to serve as a vehicle in the constructive work, the Oregon Society of Engineers has issued a call for "copy" to be used in a "discussion" department of its organ. The publication committee, of which H. L. Vorse is chairman, has made the following appeal:

"Your society, in directing this committee to make a success of the *Journal*, authorized it to commandeer such of the mental energy of the members as would seem to be useful. We believe the *Journal* should represent something more than the mere doings of the society. It should become a clearing house of ideas—a medium for pleasurable enlightenment of members and others—and it should be made to serve us as a vehicle in our constructive work both in our individual upbuilding as well as in our united professional thrust forward for greatness.

"The engineer never had a better opportunity than to-day to claim his own, and the measure of his ultimate success will be the keenness of realization of his present advantage. Don't hide your light under a bushel. If the engineer possessed one-half the social and political acumen of any other professional man he would be on the throne of greatness instead of wishing to be.

REDUCE THOUGHTS TO WRITING

"Suggest a topic for discussion by the society. Elaborate it just a little—inject a bit of original thought and dress it off with a very short peroration and launch it purely as a speculation.

"If we were to propound as thesis 'Should the federal government own and operate all transcontinental railroads, leaving only feeders to private ownership?' we feel sure you would bud ideas with the reading of the subject. You would be for it or against it, and you would know why and be able to give your view. If in that case you would reduce your words to writing and send the manuscript in, we probably would have something of value.

"Remember that every publication is being scanned very closely now for ideas that make for progress in the nation's social and industrial preparedness. Remember that one's own remarks, if well chosen and indicative of a fertile mind, not necessarily backed with experience, could, and frequently do, prove the shafts that hit the mark and transform a mediocre career into one of vast power for good and extended leadership, in thought and action, of the multitudes who must ever be led.

"We must first conquer in the fields of expressed opinion before we may be permitted on the stage of action. We defy you to name one individual who has attained a dignified prominence that did not come primarily from his written or spoken words rather than from some mere act of usefulness.

"There are fertile fields scarcely touched in which discussion may bear fruit. The labor problem is an old one considered in the abstract; but who ventures to say we are not entering upon a page of unwritten history? Consider the labor problem in all its aspects—in the light of recent federal legislation, finished and yet to come; the actual labor supply to-day and what it will be at the close of the war; the present pressing need for menial labor and for a time at least skilled labor; the question of hours, pay and the necessity for getting things done.

"In suggesting subjects, deal with the various affairs of life and get away from the purely technical or mathematical problems of the day. You should remember, too, that the six papers of this issue and a like number of the first issue of the *Journal* should furnish you material for discussion. Or do you agree with everything said? We do not; we presume you should not. The authors of those papers made no pretext at exhausting the subject. We think they merely scratched it in several instances. A 'discussion' department of the *Journal* is waiting for copy."

Gives Instructions on Care of Earth Roads in Winter

Illinois Highway Engineer Recommends Use of Drag Before Freezes, Watching Weather Predictions for the Exact Cue as to Time

THE FIRST way to care for an earth road in winter, according to a statement by Frank T. Sheets, assistant maintenance engineer, Illinois Highway Department, in the December issue of *Illinois Highways*, is to prepare it for this care by intelligent work in the summer, paradoxical though the statement may seem. No one should expect or permit an earth road to enter upon the winter period in a flat, undrained condition. The road should be well crowned, adequate side ditches provided and underdrainage placed wherever deemed necessary.

In winter it is essential, says Mr. Sheets, that the ditches, drains and culverts be watched and all obstructions to drainage removed. A few minutes' use of a shovel may eliminate a saturated roadbed or a stopped-up culvert. Keep the ditches and culverts clean. Then when rain falls or snow and ice melt, far less damage will result.

It is unavoidable that the surface should be cut up under traffic during a thaw or a rainy spell. Yet no one can say that it is necessary to let this surface freeze in such a condition. Nothing more unpleasant can be experienced than traveling over a rough, rutted and frozen surface.

The road drag comes to the rescue of the earth road in winter with the same efficiency as in summer. If a rough, cut-up road is dragged before a freeze and then frozen in a smooth condition, a boulevard is enjoyed until the next thaw. If a wet surface is dragged and then dried, a good road is also enjoyed.

Common sense will soon teach how to perform the work. A study of weather predictions and a corresponding use of the drag at opportune times will work wonders in the winter with Illinois roads.

To Compute Stress in Spiral-Riveted Steel Pipe

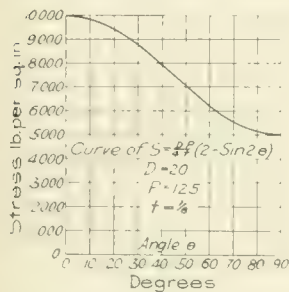
Theoretical Analysis for Normal Stresses in Gross Sections of Joints—Diagram Shows Variation with Angle of Spiral

By ARTHUR JOBSON
Casper, Wyoming

THE DESIGN of spiral-riveted pipe is of course directly dependent on the angle of spiral. An analysis to include the effects of both longitudinal and radial forces induced by internal pressure is here presented, together with a diagram to indicate the variation of stress normal to the joint with the angle of the spiral. There is also derived a formula for angle of spiral for a given riveted joint efficiency such that the strength of the joint will be equal to the full strength of the plate on a longitudinal section.

NOTATION USED

In order to derive the desired equations, the notation shown on the drawing herewith will be used, and in addition P is the internal pressure in pounds per square inch; F_1 , the total force $\pi D^2 P/4$ acting parallel to the axis of the pipe due to the internal pressure; F_2 , the corresponding total force $DLP/2$ acting normal to the preceding and tending to rupture the plate longitudinally; R , the resultant of F_1 and F_2 normal to the direction of the spiral joint; t , thickness of plate, and θ is the angle between the joint and the longitudinal axis.



VARIAION IN UNIT STRESS
WITH ANGLE

There can then be written:

$$\begin{aligned} R &= F_1 \cos (90 - \theta) + F_2 \cos \theta \\ &= F_1 \sin \theta + F_2 \cos \theta \\ &= \frac{\pi D^2 P \sin \theta}{4} + \frac{DLP \cos \theta}{2} \end{aligned} \quad (1)$$

To find the unit stress S in the plate (in pounds per square inch) produced by the resultant force R , it is necessary to divide this force by the area of the plate normal to R . For convenience, assume that the length of the section under consideration is equal to the pitch p of the riveted joint. Then the area of the plate normal to R will be $tp \sec \theta$, and substituting $L = p$, there is obtained

$$S = \frac{\pi D^2 P \sin \theta \cos \theta}{4tp} + \frac{DP \cos^2 \theta}{2t} \quad (2)$$

But $p = \pi D \cot \theta$; therefore

$$S = \frac{DP}{4t} (\sin^2 \theta + 2 \cos^2 \theta) \quad (3)$$

Substituting the value of the cosine in terms of the sine, equation 3 reduces to:

$$S = \frac{DP}{4t} (2 - \sin^2 \theta) \quad (4)$$

It will be noted that for the limiting values of θ the last equation reduces to the usual expressions for computing the circular and longitudinal unit stresses in closed cylinders subject to internal pressure. For in-

stance, when $\theta = 0$ deg. the helix becomes a longitudinal line and $S = DP/2t$, and when $\theta = 90$ deg., $S = DP/4t$.

The table herewith gives the values of $2 - \sin^2 \theta$, S , and the pitch p in inches for values of θ from 0 to 90 deg. The unit stress S is computed on the assumption that D is 20 in., P is 125 lb. per square inch and t is $\frac{1}{8}$ in., gross section.

UNIT STRESS S AND PITCH p FOR VARIATION IN ANGLE θ

θ	$2 - \sin^2 \theta$	S	p
0	2.0	10,000	∞
10	1.9697	9,848	356
20	1.883	9,415	173
30	1.75	8,750	109
40	1.5865	7,933	75
45	1.5	7,500	63
50	1.4132	7,066	53
60	1.25	6,250	36
70	1.1164	5,582	23
80	1.03	5,149	11.1
85	1.008	5,040	5.5
90	1.0	5,000	0.0

The variation of the unit stress for corresponding values of the angle θ is shown graphically in the diagram.

It will be noted from the table that the stress in the

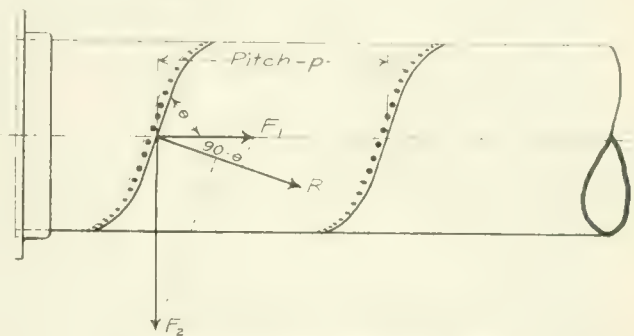


DIAGRAM SHOWING NOTATION USED

plate normal to the direction of the spiral joint when θ has a value of 70 deg. is about 56 per cent of the unit stress longitudinally. As this is about the efficiency of a single-riveted lap joint, it is evident that the pipe is not appreciably weakened by a joint; in fact, the results indicate that for values of θ greater than 70 deg. the joints are considerably stronger than the full area of the plate on a longitudinal section.

To find the angle θ for a given riveted joint efficiency such that the strength of the joint will be equal to that of the plate for a longitudinal section, let E be the efficiency of riveted joint in per cent, and S_l the longitudinal unit stress; there can then be written:

$$S_l = \frac{DP}{2t} = \frac{100DP}{4Et} (2 - \sin^2 \theta)$$

Solving, there is obtained:

$$E = 50 (2 - \sin^2 \theta) \quad (5)$$

$$\sin \theta = \sqrt{2 - E/50} \quad (6)$$

The angle θ is easily found in any particular case by measuring the diameter of the pipe and the length of the pitch, and substituting these figures in the expression $\tan \theta = \pi D/p$.

The value of θ given by equation 6 may be considered the critical angle for a given riveted joint efficiency. That is, for any angle between this critical value and 90 deg. the spiral joint will be stronger than the longitudinal section of the plate, and for angles smaller than the critical value the riveted joint will be weaker than the longitudinal section.

Heavy Bracing Gives Large Open Pockets in Deep Cofferdam

Power Plant on Ohio River Requires Large Amount of Scattered Tunnel, Foundation and Concrete Work—Problem to Get Gravel from River to Job

A VERY LARGE braced cofferdam, excavated to the unusual depth of 65 ft. below the surface, has recently been used with success in building a reinforced-concrete condenser pit for a big steam-electric power plant at Beach Bottom, 8 miles above Wheeling, W. Va., on the Ohio River. The condenser pit is for the first of three units, each of which will generate 30,000 kw., using coal delivered from a mine directly behind the plant, and transmitting power across the river for use in that section of Ohio. Besides the main cofferdam, for which a type of bracing giving large open pockets was developed, the work also includes deep open-well foundations for the boiler plant and for the transmission-line towers on both sides of the river, and inlet and outlet tunnels emerging below low water, the ends of which were inclosed in an open-box cofferdam in the river. The variable river stage, and the fact that the Pennsylvania Railroad lies between the main buildings and the river, from which sand and gravel were obtained, gave rise to an interesting problem in material supply.

The work was developed with stiffleg derricks placed

on piles around the open pit in which the main cofferdam was started. This pit was dug 20 ft. deep with grab buckets over the site of the main power plant. The spoil was disposed of south of the plant by dump-car trains and two steam dinkeys. Wood sheeting 4 ft. outside of the proposed lines of the steel coffer was then driven 12 ft. deeper and excavated. The top layer of bracing was next placed and 40-ft. arch-web Lackawanna steel sheeting stood up around it and driven to rock with steam hammers. The bracing was designed with built-up members able to sustain triple the load allowable on a 12 x 12-in. timber. This made possible large pockets, in which dredging could be done cheaply, and in connection with the arch-web sheeting permitted a 6-ft. vertical span between layers. This construction gave one-third the usual number of cross-struts to handle in carrying up the concrete, and made both formwork and concreting much easier. As will be seen from the photographs, the struts parallel to the river consisted of two 12 x 12-in. timbers on top and one beneath, while those perpendicular to the river were made with one timber on top and two beneath.

A central group of nine pockets was formed in this way, from the corners and intersections of which single 12 x 12-in. timbers ran fanwise to the wales, each of which was made with three horizontal courses of 12 x 12-in. timber.

TUNNELS STARTED FROM RIVER

While this cofferdam was being excavated and braced two derrick boats dredged and built a box-coffer around the river end of the intake and discharge tunnels. This work was started in the fall of 1915, and a traveler derrick, set up above the line of the tunnels, began to sheet and excavate a trench for them as soon as the coffer had been pumped out. The tunnels had been built and backfilled to the edge of the high river bank when winter and spring floods interrupted work on them until this summer. They have been driven through beneath the railroad in timbered tunnels to meet the sections constructed inside the condenser-pit cofferdam during the past season.

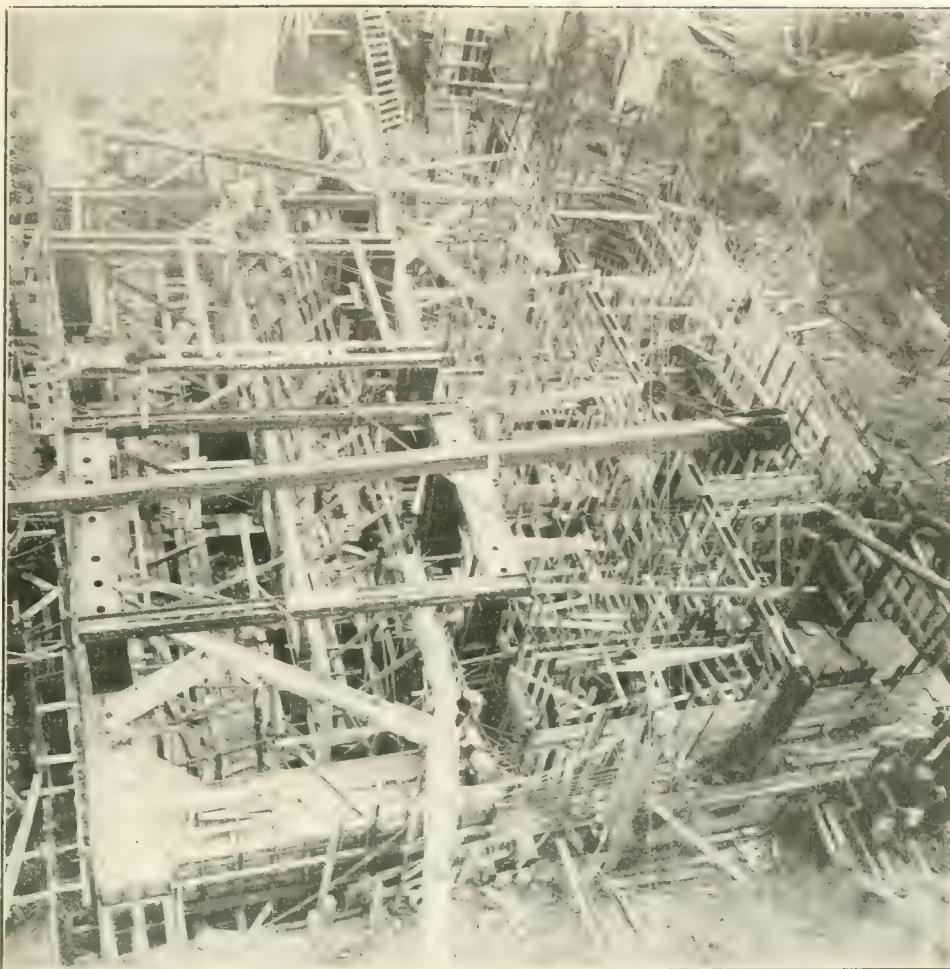


EACH LINE OF BRACING ACROSS HUGE COFFER IS MADE OF THREE 12 X 12S

The same rises in the river were taken advantage of, however, to stock 11,000 yd. of sand and gravel on the top of the bank between the railroad and the river. This material was dug by a sand dredge, loaded into barges, and cast by one of the derrick boats on the bank at the water's edge. A traveler derrick picked it up here and stacked it at the top of the bank. A second traveler, moving into these piles, has this year loaded them, using a portable hopper, into dump buckets on flat cars which are hauled to the concrete plant by a dinkey through a small tunnel under the railroad.

Though this triple handling may seem expensive, no substitute for it was feasible. The Ohio has its moods, in some of which the shoal bottom on the east side at this point is exposed 300 ft. from shore, and in others of which ice and driftwood are swept along at a rate that would make short work of a material trestle. Frequently the sand dredge could not work at all. The only insurance of continuous concreting was a large stock pile. Considering the 40-ft. range of the river, and the fact that a traveler derrick submerged for a few days comes up ready to run, while a conveyor or similar device would be lucky to come up at all, no cheaper method of handling the aggregate could have been found.

However, storage space was limited, and the river erratic. Enough material to complete the job could not be handled in this way, and a trestle, built this summer out to deep water, and ending under a hopper fed by a derrick boat, was used as continuously as

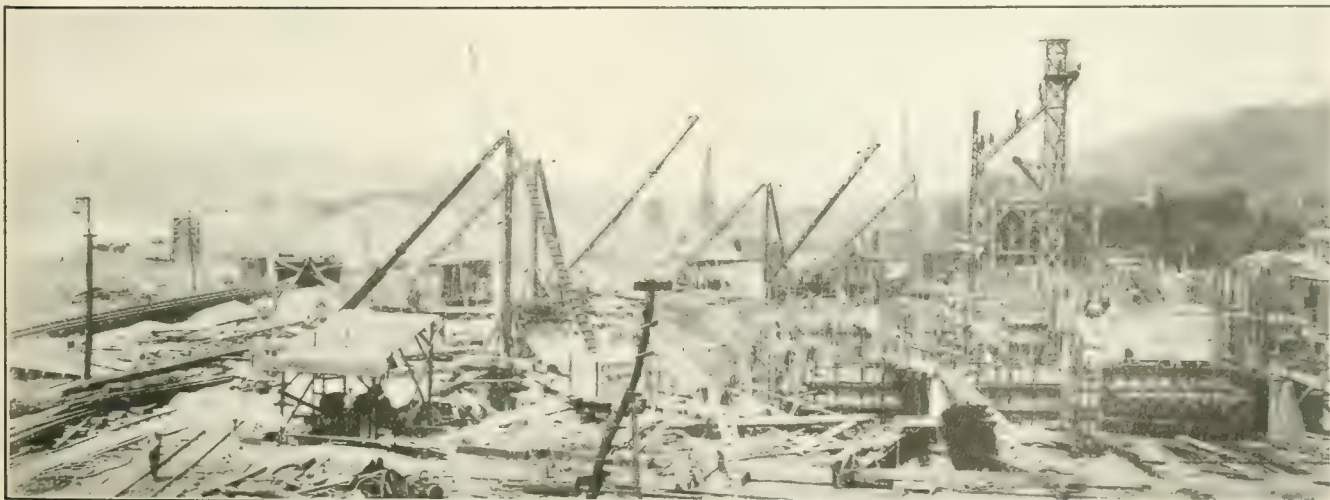


LARGE OPEN POCKETS IN BRACING NEEDED FOR HEAVY STEEL AND CONCRETE CONSTRUCTION

possible, the last of the storage pile serving as a reserve.

The concrete plant, covering with a tower and a spouting system the main power plant, is located north of the cofferdam. Its 1-yd. mixer is set under 30-yd. bins into which a derrick dumps the 1-yd. material buckets. Cement is delivered by rail to a four-car cement house adjoining the plant.

The concrete for the transmission-line foundations on both sides of the river was mixed in portable mixers. A mixer of this type was also used for concreting the



BIG INTAKE WELL AT RIGHT CONNECTS WITH OHIO RIVER THROUGH TUNNELS UNDER RAILROAD AT LEFT

MacArthur piles, 215 of which were driven for the support of the apparatus-shop building north of the main plant. For the open-pit foundations, from rock up to ground level, concrete was spouted directly into the rectangular wood-sheeted wells. Above that point it was handled by the skid derricks which sunk the wells. The small amount of cement and aggregate required on the west bank was thrown up by a derrick boat and loaded by a traveler into wagons which took it to the tower sites.

EXTRA PLANT, FROM DAM COMPLETED BELOW, PUT TO GOOD USE

After the concrete work in the condenser pit had been given a good start, work was begun on as many of the wells outside of it, which will support the rest of the main plant, as were not beneath the derricks required to handle the heavy structural-steel reinforcing in the condenser pit and pull the steel sheeting. As these wells were finished additional derricks were set on them and used to take the original derricks down. This procedure, which saved many days' delay over shifting the first derricks, was possible without extra cost because more plant than was actually required on the job had been released by the completion of government dam 12, 5 miles downstream, and brought to Beach Bottom on the company's barges by a river steamer built for constructing the dam. This steamer and the sand digger, a side-ladder dredge also used at the dam, considerably cheapened the cost of supplying aggregate for the power-plant contract.

Most of the construction above ground is steel frame with brick walls and concrete floors. By the end of July last the foundation work had advanced sufficiently for the steel contractors to make a good start on erection, and the structures above ground are now nearing completion.

SAVING STEPS FOR THE MECHANICS

The job is equipped with a woodworking machine and blacksmith shop, placed end to end with each other and the storeroom, south of the work. The steel and pipe-stock racks are arranged against the buildings. In this way the high-priced machinists, pipefitters and carpenters do not have to waste time looking all over the work for tools and materials with which to do little jobs. The carpenter shop contains band and rip saws, and the machine shop is equipped with threading tools, a lathe, and a drill press.

The plant was designed by Sargent & Lundy, engineers for the owners, the American Gas & Electric Company. The Foundation Company is general contractor for the entire work. Operations are under the direction of George R. Johnson, district manager, with H. B. Kelsey in charge as superintendent.

Longest Concrete Road in Utah

With the completion of a 3-mile stretch of 16-ft. concrete road from Lagoon to Kaysville, on the highway between Salt Lake City and Ogden, Utah, approximately one-half of the 37-mile stretch between Salt Lake City and Ogden will have been completed. This, according to the Portland Cement Association, will make one of the longest continuous stretches of concrete in Utah.

Profession Defined—Wage-Earning Engineers Not Yet Members

F. H. Newell Tells Cleveland Engineering Society How Best to Serve Men Who Have Not Reached Goal as Well as Those Who Have

WHAT distinguishes the professional man from the mechanic was set forth to the Cleveland Engineering Society at a meeting last November by F. H. Newell, professor of civil engineering at the University of Illinois. In his address, "A Practical Plan of Engineering Co-operation," he defined a profession as "a calling in which one professes to have acquired some special knowledge used by way either of instruction, guiding or advising others or of serving them in some art." Under his definition engineering societies are made up largely of men not yet professional men, though aspiring to be. Hence he holds that the societies must modify themselves to serve these men, as well as those who have arrived, and he cites four lines—employment, publicity, better laws and ethics—in which the societies can assist its members.

Extracts from his address follow:

WHAT DISTINGUISHES A PROFESSION

"The first and most distinctive feature [of a profession] is the fact that the doctor, and the lawyer as well, does not work under the immediate direction of some other person, nor does he perform certain set operations within certain hours. He is called in not to carry out instructions of an employer but, on the contrary, to dictate to the man who ultimately pays the fee when, where and how certain things must be done. He ceases to be a professional man the moment he takes orders from an employer.

"More than this, the doctor, the lawyer, and the minister as professional men glorify in the fact that they set the practice of the profession above remuneration. They have devoted their lives to a certain work for the love of the work and not for the money rewards. To the needy their services are free; no mechanic is called upon to work for nothing—the doctor frequently is. In theory, at least, they do not accept direct pay for so many hours' service, but finding it necessary to live and maintain a suitable status in society they accept a fee, a retainer, a stipend, or an honorarium—never wages.

"This matter of wages, salary or fee is an index of the consensus of opinion as to what is or what is not a profession. It is not, of course, the way in which the money itself is paid or received, but the underlying theory as to whether on the one hand you are working under the direction of someone else who is dictating how you shall work, or, on the other, whether you are exercising the rights and duties of a professional man in determining how your patient or client shall or shall not conduct his affairs.

WAGE EARNERS NOT STRICTLY PROFESSIONAL

"The moment we recognize clearly the fact that the men who join the engineering societies are not as yet professional men, although looking forward to that condition, then it follows that we must modify our organizations and methods to accomplish the largest good to

the greatest number. With this condition in mind, namely, that while some may be professional men in the strict sense of the word, yet the great majority, particularly of our younger men, are not professional, but are more of the nature of wage earners, we must look around us and see what similar organizations of other men are doing. We must try to help each other by an exchange of ideas, by an exchange of experience, so that we as an organization may perform our full duty, not only to our own members, but to the public in general.

CONFUSION IN GROUPS

"We must clearly face this confusion and must endeavor to distinguish and straighten out the lines between the mechanics, often miscalled engineers, the real engineers who are technically educated and are serving as employees, the business men who are educated as engineers and who are properly members of an engineering organization, but who are in engineering as a business; and the independent practitioners who originally built up the older engineering societies, largely following the precedents set by the organization of the doctors and of the lawyers. The times have changed and this confusion of terms must bring about a great deal of discussion, a conflict of ideas. Thus we must, when considering the function of the engineer, clearly distinguish as to which of these kinds of men we have in mind and what are the classes of men to be benefited by our organization.

DUTIES OF LOCAL ENGINEERING SOCIETIES

"Under that assumption, that the majority of the members of our local engineering associations are not professional men as yet, but should have before them the ideals of the professional man that they may grow into the profession, what are the things most important for this association and for all associations to do for the benefit of its members and of the public in general?

"When we recognize that any local engineering society must necessarily be composed not merely of a nucleus of professional men, but to a large extent of young men technically trained and competent to become professional men, then we see more clearly the answer to these questions. Our activities must be directed toward the needs not merely of the small number of mature engineers but, more than this, to the proper relations of the younger men. These needs may be enumerated under several headings, in each of which the Cleveland society has already distinguished itself. They must be considered under the headings (1) employment, (2) publicity, (3) better laws and (4) ethics."

EMPLOYMENT, PUBLICITY, BETTER LAWS AND ETHICS

On the score of employment Professor Newell cited the handicap under which the engineer labors when out of work, mainly because his pride and professional ideals prevent him from proclaiming his abilities. The engineering society, Professor Newell thinks, "should say things for him that he cannot say for himself and that he cannot ask us to say," providing him with something akin to employment insurance; and at the same time it should strive to the end that "the square pegs may fall into the square holes and the round pegs into the round holes."

Publicity of the right sort, in the estimation of Professor Newell, is the establishment and maintenance of good understanding on the part of the public as to what engineers are doing. This does not mean self-seeking advertising. It does mean putting out "clearly and frequently statements acceptable to the daily press which systematically bring about the proper appreciation of engineering work."

Under the third head, better laws, Professor Newell urges the engineer and engineering societies to take a more active part in revising the laws to meet the exigencies of modern changing conditions. And as to ethics, he urges that it be no longer assumed that the engineer is honest because he is an engineer, but that much more attention be given to the discussion of codes and their enforcement by local associations. Only thus, Professor Newell thinks, can men of high ideals be protected against the less scrupulous.

California Waterwheel Built in 1868 Still in Service

**76-Inch Wheel with Built-Up Wood Center at Quincy
Sawmill Was Much Improved in 1880
with Remodeled Buckets**

By J. W. SWAREN
Hayward, California

NEAR Quincy, Cal., one of the oldest operating waterwheels on the Pacific Coast is driving a sawmill cutting lumber for local needs. It was built in 1868, remodeled in 1880, and is still in regular service when required. It has a built-up wood center, 76 in. in diameter at the pitch line, with an 8-in. face. It has a 3-in. wrought shaft, with wrought side plates. A built-up wood pulley for the driving belt is mounted on the shaft.

Pine, cut with whipsaws and hand-dressed, was used in building up the center, hand-forged nails and through bolts reinforcing the dovetail construction. Some type of compound, the nature of which could not be ascertained, was applied to the wood sections, and in general appearance these seem of recent construction. A close examination, however, confirms the age. When the untreated planking that incased the wheel was removed to permit photographing, much of it crumbled into dust.



WATERWHEEL NEARLY 50
YEARS OLD STILL ON DUTY

As originally built, it had flat wooden buckets dovetailed into the rim. During the summer of 1880 Lester A. Pelton, who had just completed the development of the divided bucket, replaced these wood buckets with cast-iron buckets, doing the work in person. Old residents comment on the increased output of the sawmill after the new buckets were installed.

The original nozzle, 1¼ in. in diameter, is still in service, though rather water-worn. It operates under a head of 125 ft. Sheet-iron pipe, of the type used for supplying hydraulic giants in the early mining days, is used for the penstock.

This wheel is on the ranch of H. C. Fluornoy, manager of the Quincy Light & Power Company, and son-in-law of Judge Ganser, who made the original installation.

In strange contrast to this unit is the unit of the power company less than a hundred yards distant, which is equipped with every possible refinement that the hydraulic engineer can devise in order to secure maximum output from a limited stream flow.

Trench Construction Now Governed by "Safety Orders"

California Accident Commission Prescribes What Shoring Must Be Used for Different Depths and Kinds of Material

THE workmen's compensation and insurance act of California passed in 1913 empowers the Industrial Accident Commission "to make and enforce safety orders and to fix safety standards." In line with its policy of extending its supervision to all fields of construction where safety regulations are needed, the commission has just issued a set of "Trench Construction Safety Orders," effective Jan. 1, 1917.

Committees, including representatives of large contracting firms, the Accident Commission, municipalities, the Casualty Underwriters' Association of California, the Central Labor Council, and the United Laborers' Union, met and agreed upon limitations which the commission has embodied in safety orders 1000 to 1006 inclusive. These orders will hereafter govern in trench work over which the commission has jurisdiction.

PILING AND SHORING

After defining a trench as "any excavation, other than railroad or highway cuts, in which the greatest depth is equal to or greater than the width," the orders state that "where running material is encountered the sides of all trenches 4 ft. or more in depth shall be secured by the use of sheet piling and suitable braces, as defined in these orders.

"Where trench is between 4 ft. and 7 ft. in depth, wooden sheet piling shall be not less than 2 in. in thickness. Where trench is over 7 ft. in depth, wooden sheet piling shall be not less than 3 in. in thickness.

"The sides of all trenches in hard, compact material which are 5 ft. or more in depth and over 8 ft. in length shall be securely held by shoring and bracing. If the unit-tunnel method is used, the length of earth left in place between the separate unit trenches shall be not less than one-half the depth of the trench, and shall be considered as taking the place of shoring and bracing.

"All trenches of over 8 ft. in length and 5 ft. or more in depth in hard, compact material shall be braced at intervals not exceeding 8 ft. with 2 x 6-in. planks, or heavier material, placed vertically in the trench opposite each other against the walls. These braces shall, if possible, extend to the bottom of the trench; otherwise

as low as possible to clear the top of pipe, sewer, conduit or other material to be placed in the bottom of the trench.

"The braces in trenches shall be supported by screw jacks or by timbers placed normal to both braces, cleated and rigidly screwed or wedged. The timbers shall be not less than those given in the following table:

Width of trench, ft.	Size of timbers, in.
1 to 3	4 x 4
3 to 6	4 x 6
6 to 8	6 x 6

"The number of horizontal strut braces, either screw jacks or timbers, required for each pair of vertical braces shall be determined by the number of zones of 4 ft. each into which the depth of trench may be divided. One horizontal brace shall be required for each of these zones. Trenches, the depth of which cannot be divided equally into these standard zones, shall have an extra horizontal brace supplied for the short remaining zone if such zone is greater in length than one-half the 4-ft. unit. In no case, however, shall horizontal braces be spaced greater than 5 ft. center to center.

BRACING MUST PROCEED WITH EXCAVATION

"The bracing and shoring of trenches must be carried along with the excavation, and must in no case be omitted, except that where a mechanical digger is used the shoring shall be placed to within 10 ft. of the lower end of the boom. Stringers shall be not less in strength than 2 x 6-in. clear timber."

The orders also provide for "adequate" sheeting in saturated ground, that excavated material may not be placed within 1 ft. of the edge of the trench and that in all trenches over 5 ft. deep suitable ladders shall be provided every 200 ft. or less.

Travel on Main Highway Increases

It is a difficult thing to determine what type of construction should be adopted for the improvement of some main highways. If by any chance they become parts of through routes for motorists, the travel over them will increase enormously and a more expensive road will be needed than if they are used only as main market roads. The American Highway Association cites the following figures to support this statement: When the Massachusetts Highway Commission began in 1909 to investigate the travel on the shore road from Boston to the White Mountains, they found that at Rowley this travel was made up of an average of 97 automobiles and 199 other vehicles a day, while in 1915 it had increased to 650 automobiles and 109 other vehicles. On an old turnpike from Boston to Newburyport the average number of users of the road in 1909 at a point 20 miles from the former city was 11, of which 4 were automobiles. In 1915 there were 341 automobiles and 6 teams using the road daily. On the old Mohawk Trail in 1912 there were 23 teams and 7 automobiles passing Florida Mountain, while in 1915, when many parts of the route were still merely dirt roads, there were 266 automobiles and 21 teams passing daily, on an average. On the Sunday before Labor Day of that year 3268 automobiles passed over the mountain.

Concrete Contractor Can Use Labor-Saving Plant to Cut Cost

Uncertain Labor Conditions Make Profitable Installations Costing 35 to 42 Cents per Cubic Yard to Erect and Dismantle

By W. P. ANDERSON

President, Ferro-Concrete Construction Company, Cincinnati

LABOR CONDITIONS during the last year have made it profitable for contractors engaged in building reinforced-concrete structures to make the fullest possible use of labor-saving equipment. The extent to which mechanical equipment for handling materials is proving profitable in such building work is well brought

overhead storage bins feeding the mixer by gravity. Both sand and gravel were dumped into the track pit, the material being deflected at the top of the elevator into the sand or gravel compartment of the bins, as the case might be, by a gate between the bins.

On the completion of this contract the same plant was adapted to truck delivery of materials on the French-Bauer Building by providing a pit, covered with a grating in the street, through which material was dumped from wagons.

At the East Side High School the concrete materials were unloaded from railway cars to overhead bins or into reserve storage piles by a derrick with a clamshell bucket. Stone and sand were drawn from the bins into a small measuring car with two marked compartments



DROP CHUTE AND TWO SPOUT LINES FROM ONE TOWER SAVE RIGGING—GRAVITY UNLOADERS CUT HANDLING COSTS

out by two contracts, one recently finished and the other nearing completion, carried out in Cincinnati during the last season by the Ferro-Concrete Construction Company. The concrete plants on the contracts, one of which was for a group of buildings for the East Side High School and the other for a mill and warehouse for the Ubiko Milling Company, were illustrated, together with a number of other concrete plant layouts, on page 199 of the Engineering Record of Aug. 12 last.

NUMBER OF LABORERS REDUCED

The object of these two installations was, as stated, to reduce the number of common laborers required by doing away with all hand shoveling, charging the mixers by gravity and decreasing the amount of labor needed in handling the chutes used to place concrete directly in the forms. At the plant of the Ubiko Milling Company this was accomplished by dumping the cars of concrete materials into a small bin under the track, from which a bucket elevator carried them to

which ran along an elevated track in front of the bins and dumped directly into the charging hopper of the mixer. The cement at this plant was unloaded and handled on gravity rollers, and the form lumber, tile and other materials were unloaded in the same way.

MOVABLE HOPPERS ON CONCRETE TOWERS

At both plants the concrete, after being mixed, was hoisted to movable hoppers, which could be set at any desired height on the tower, and thus spouted to place. The main tower at the East Side High School plant was provided with two hoppers so that concrete could be spouted alternately for long and short distances without materially changing the rigging of the chutes. The amount of rigging required at this plant was further reduced by having drop chutes set in the main chute lines at convenient points. At both plants, the first length of chute and the upper end of the second length were supported from split booms. The upper chute line for the high-

LARGE COST OF CONCRETING

	Ubiko Plant	Ware-house	East Side High School
Installing and wrecking equipment	\$0.424	\$0.126	\$0.350
Unloading sand, cement and gravel...	.265	.265	.171
Mixing concrete	.272	.204	.263
Hoisting and placing concrete and handling chutes	.300	.300	.17
Cleaning up, care of sacks, and miscellaneous	.17	.14	.040
Protection on account of winter work	.003		
Labor cost per cubic yard	1.482	1.391	1.299
Total yardage	2,407	907	4,661

* Partial yardage; work not yet completed.

school buildings, however, which remained fixed during most of the work, was hung from a guy cable between the main tower and a centrally located tail tower. For supporting the lengths of chute within the lines of the buildings, tripods mounted on iron wheels about 30 in. in diameter were used. The large diameter of these wheels made it possible to roll the chutes around over reinforcing steel already in place, or on the forms or finished surface, with little labor. In addition to the wheeled towers a low "bicycle" frame on



WHEELED TOWER FIGURES IN SUPPORT OF CHUTE LINE

two similar wheels was used to carry the delivery end of the chute line at the Ubiko plant.

The labor costs given in the table were realized with common labor at 25 to 30 cents per hour on the Ubiko job, most of the men receiving the lower rate, and at an average of 28.5 cents per hour on the high-school job. The yardage indicated in the table so far placed at the high-school job is considerably below the total quantity of concrete required; but as the total yardage has been considered in estimating the cost for installing and wrecking the equipment and for cleaning up and miscellaneous work, it is expected that the unit figures given will prove approximately correct at the close of the work. It is interesting to note that with the higher unit cost for installation on the smaller contract a lower cost for mixing and placing concrete was realized. The figures make it appear also that the grab-bucket rig has a considerable advantage over the bucket conveyor. It must be considered, however, that it was not always possible to secure materials in bottom-dump cars. Moreover, the design of the conveyor in this plant proved faulty, and a heavier one is now in use on the second contract.

It is believed that if buggies had been employed in distributing the concrete and hand shoveling had been required in unloading materials or supplying the mixers, the total unit labor cost, in spite of a possible reduction in the item for installation, would have been so much greater as to overbalance the saving on interest and depreciation charges that might have been realized by using less plant. Moreover, it would probably have been impossible to secure sufficient labor to carry on either of these contracts at the speed actually attained, which would have increased the overhead cost of the work.

Reclamation Engineers Determine Friction of Bronze on Bronze

Tests Made Under High Pressures at Pathfinder. Arrowrock and Elephant Butte Dams Give Needed Data for Gate Designs

RESULTS of experiments to determine the coefficient of friction of bronze on bronze required under high pressures in the operating mechanisms for large, high-pressure sluice gates are given in the January *Reclamation Record*. Slide gates at the Pathfinder, Arrowrock and Elephant Butte dams were tested. These gates are provided with cast-bronze bearing surfaces of the following chemical composition: Gate leaves, 82.8 per cent copper, 8 per cent lead, 4.4 per cent tin and 4.8 per cent zinc. The gate seats are composed of 82.7 per cent copper, 4.9 per cent lead, 5.3 per cent tin and 7.1 per cent zinc.

The gates are operated by oil pressure on pistons moving in cylinders mounted on the gate bodies. In making the tests pressure gages were placed at the top and bottom of these cylinders, and the operating force was determined from reading these gages. Internal friction of moving apparatus was approximated by the oil pressure necessary to move the gate near its wide-open position. The weight of moving parts was known and allowed for. The gates were moved so slowly that no correction for momentum was needed.

PRESSURES AND FRICTIONAL RESISTANCES

Pressures were observed and frictional resistances were determined for the gates in various positions from closure to full open. With few exceptions, smaller friction factors were found with the gates partly open. This was probably due to vibration in the gate leaf, and the results obtained were apparently not reliable except for the position near closure. The results obtained in tests on two gates at Pathfinder, five at Arrowrock, and two at Elephant Butte, all in practically closed position, are as follows:

Item	Pathfinder	Arrowrock	Elephant Butte
Size of gates (larger dimension vertical), feet	4.42x7.5	5x5	3.92x5
Head on center of gates, feet	127	48.5 to 54.8	107.3
Average time of opening, minutes	16	10	5.2
Average time of closing, minutes	14	11	4.2
Friction coefficient:			
Average for opening stroke	0.42	0.31	0.336
Maximum for opening stroke	0.44	0.42	0.383
Average for closing stroke	0.29	0.29	0.254
Maximum for closing stroke	0.31	0.34	0.268

The gates tested had been operated previous to the experiment at intervals of not over two months.

Resurface Water-Bound Macadam with Asphalt Macadam

For 37 Cents a Square Yard Four-Year-Old Raveled Road 7400 Square Yards in Area Was Brought Back to Good Condition

A NEW SURFACE of asphalt macadam and an increase in width of from 9 ft. to 13 ft. were applied this past season to the Fenton Road leading out of Flint, Mich., at a cost of 37 cents per square yard. The original road was 6 to 8 in. thick, built in 1912 and 1913, and was badly rutted. Many holes and depressions had developed.

The old road was first swept free of all loose material and dirt. A scarifier was then used to loosen up 2 ft. of dirt and gravel berm at both sides of the 9-ft. macadam roadway. The space was then cleaned out to a depth of about 4 in., and crushed stone ranging from 2 to 1 in. in size was placed and rolled to the grade of the old macadam. All depressions over 2 in. in depth were brought to grade with crushed stone, and the road was then thoroughly rolled to its full width. Over this surface was spread crushed limestone ranging in size from $2\frac{1}{4}$ to 1 in. This course was rolled with a 10-ton Port Huron roller. Stanolind paving asphalt at 110 penetration was then applied at the rate of $1\frac{1}{2}$ gal. to the square yard, at a temperature of 300 deg. Fahr., under 40 lb. of air pressure from a tank wagon equipped with an air compressor and a large firebox

COMPRESSOR DRIVEN WITH STEAM FROM ROLLER

The air compressor was driven with steam from the roller used to pull the tank wagon. Immediately following the application of the asphalt the key or binder stone was spread at the rate of 60 sq. yd. to the cubic yard, the limestone ranging from $\frac{3}{4}$ to $\frac{3}{8}$ in. in size. This was then rolled with a 10-ton roller and the loose stone swept off. Following this, $\frac{1}{2}$ gal. of asphalt to the square yard was applied, after which stone chips ranging in size from $\frac{3}{8}$ to $\frac{1}{8}$ in. were spread over the surface at the rate of 80 sq. yd. to the cubic yard. The road was finally thoroughly rolled with a 10-ton roller and opened to traffic.

In two weeks' time the traffic showed that it was properly drawing the asphaltic cement to the surface,



SPREADING STONE AT THE SIDES AND IN LOW PLACES



TWO MEN SPRAY HALF GALLON ONTO THE "KEYSTONE" LAYER

and in four months' time an asphalt mat had formed over the entire surface, completing a bituminous wearing surface firmly cemented to the old road. The yardage amounted to 7400 sq. yd.

The work was done by the county commissioners of Genesee County, Mich., under the direction of C. C. Lakin, a representative of the Standard Oil Company of Indiana.

Higher Salaries Needed for Geodetic Survey Engineers

Frequent Resignations Reduce Efficiency of the Department—Leave Service for Better Compensation Elsewhere

OUT of a total of 118 engineers employed by the U. S. Coast and Geodetic Survey, 62 have had less than $6\frac{1}{2}$ years of service and 43 have been with the Survey less than $3\frac{1}{4}$ years. Aside from the inefficiency in costs of having inexperienced officers, vessels carrying millions of dollars' worth of cargo are being subjected to the gravest risks, says the superintendent of the U. S. Coast and Geodetic Survey in his annual report.

What is necessary to make for greater efficiency, continues the report, is to pay salaries more nearly like those paid for similar or less exacting duties in other government services and in private engineering fields. During the six years following November, 1909, 66 out of 99 field officers of the Survey resigned, nearly all of them to take up work paying higher salaries or promising increases in the near future. A few objected to the hardships of the field work.

During the last seven years and until July 1, 1916, every man whose name was placed on the aid register by the Civil Service Commission was offered a position in the Survey. This, according to the report, is an unhealthy condition of affairs, as there should be so many names on the register that the appointing officers may always have a choice of at least three eligibles. The increases in the number of positions called for in the 1918 estimates are distributed in such a way as to make the salary list more attractive to those now in the service, and to engineering graduates.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Camera on Engineering Work

SIR: I have noted with satisfaction the discussion in your recent issues on the use of the camera in engineering work. The Dominion Water Power Branch, Interior Department, Ottawa, with which I am connected, has always insisted on reports from field officers being fully supplemented by satisfactory photographs, and has given special attention to having all photographs, including the negatives, properly filed. This has stimulated whatever personal interest one may have had in such work.

I believe it is now generally recognized that a camera is as essential in an engineer's field equipment as any other instrument, and warrants the same careful manipulation. The best type of camera is, however, not so easily settled. I heartily agree with Mr. Johnson's objection to lugging around a camera which will not go in one's pocket, and personally have found a camera of the size he suggests—one giving a picture $2\frac{1}{4}$ in. square—most satisfactory for ordinary work. After using a camera of this size fitted with a lens of F7.7 aperture, I am of the opinion that a more expensive lens is not essential. Such a camera, fitted with one of the newer and moderately expensive anastigmats, is inexpensive in its first cost and in its operation, and at the same time offers all the advantages of convenience and of the possibility of enlargement to any reasonable size. In fact, I have found that with the lens mentioned considerable enlargement is necessary before all the detail in the negative is properly brought out.

On the other hand, a larger camera, up to 5 x 7 in. at any rate, can be used to good advantage on construction work, particularly where the camera need not be carried long distances, and where details are particularly valuable. It goes without saying that this camera should be fitted with the best possible lens, in which case it may be used to great advantage in reproducing large drawings at a convenient size. For some time I used on construction a 5 x 7-in. camera fitted with a first-class lens that gave results which would have been impossible with a smaller camera.

I am an ardent advocate of the small camera, preferably $2\frac{1}{4}$ in. square, fitted with a moderately good lens for general use, but also believe that, where possible, resident engineers and superintendents should be equipped with a larger camera, preferably of the reflector type, and fitted with the best possible lens.

I cannot refrain from adding a word as to the excellent and useful results which may be obtained from the panorama camera. I obtained a large number of excellent negatives $3\frac{1}{4}$ x 12 in. with a camera that originally cost only \$20, and from these negatives secured perfect enlargements up to 3 ft. in length.

It seems to me that in a great many cases ultra-expensive lenses are not warranted, and that, on the whole, better results are to be obtained by emphasizing the need for more careful manipulation of the moder-

ately priced camera than by urging the necessity for high-priced equipment. I have in mind one particular example of this kind, where an assistant had a comparatively cheap camera which he claimed was no good, but who, after a little coaching, is now producing first-class pictures with this camera under all kinds of conditions.

K. H. SMITH,
Resident Engineer, Dominion Water Power Branch.
Halifax, N. S.

SIR: After reading Mr. Johnson's letter relative to the camera on engineering work and the filing of prints and negatives, in your issue of Dec. 16, 1916, page 750, I would like to suggest a method of filing which I have used for the last four years.

On the glossy side of a film negative, with black drawing ink put, for instance, the number 160923c. The first two digits stand for the year, the middle two for the month and the last for the day, the letter c (third letter in the alphabet) meaning the third picture taken that day. No letter need be used if only one picture is taken on any one day. In printing, this number is transferred to the picture.

Besides having a number by which to file and index your pictures and negatives, the date of the picture, which is the impossible thing to remember about any picture, is incorporated in the number. If the negatives for each month or year are kept in envelopes, with numbers running consecutively and the envelopes marked accordingly, any negative is very readily found from the picture.

This method of numbering is also applicable to the numbering and filing of jobs, drawings, etc.

Ann Arbor, Mich.

W. BINTZ.

Water the Chief Factor in the Making of Good Concrete

SIR: The article "Water the Chief Factor in the Making of Good Concrete," by Nathan C. Johnson in the Engineering Record of Dec. 30, 1916, page 790, was read with considerable interest. The writer thoroughly agrees with all that he has said, and believes that "we face a revolution in our knowledge of the factors that go to make concrete."

In 1910 and 1911 the writer had charge of the construction of two large double-track bridges near Nece-dah, Wis. The concrete in this work amounted to approximately 10,500 cu. yd. Early in the construction of these bridges the laitance and "day's-work seams" became troublesome. A day's run did not complete the footing in one of the abutments, and the next morning the top of the concrete was covered with from $\frac{1}{4}$ to $\frac{1}{2}$ in. of slippery, clay-like material which was thought to be clay and stone dust from the crushed limestone. This was removed and the surface of the concrete thoroughly scrubbed before continuing the

work. The stone was selected with care, keeping out the clay and stone dust. The deposit was found as before. This was also removed before concreting was continued.

It was found difficult to get the concrete mixed so that we would not have excess water in the form. All materials and water were measured for each batch of concrete, but still we had trouble at times with excess water. It was finally decided that the amount of water should vary according to the judgment of the inspector, so the excess water in the form was not so troublesome and a more even mix was obtained. The concrete when dumped into the form was plastic, and the laborer, while spading in the form, would sink into it from 5 to 8 in. Excess water would occasionally accumulate in the form. This water was pushed to one end by dumping the concrete continuously from one end of the form, and at first was removed with a bucket, but later a $\frac{3}{4}$ -in. hole was made in the form just above the concrete, so it could run out on the ground.

It was thought that considerable cement was lost by letting the water out in this way, but a study of this revealed the fact that but little cement was wasted, although practically all of the laitance did pass off with the water. It was noticed that the amount of laitance seemed to vary in the different shipments of the same brand of cement, also a less amount of laitance was found if the concrete did not have an excess of water. In fact, excess water invariably caused laitance seams if it was not removed from the surface of the concrete within a short time after the concrete began to take its initial set. The concrete work on the two structures was watched carefully, and the results show few if any "day's-work seams."

The writer remembers when the contractor was not allowed to tip a bucket of concrete, dropping it 6 ft. into the footing of a large abutment, but was required to use open-bottom buckets and lower the bucket near the surface of the concrete before dumping, for fear of separating the mix and sending the coarser material to the bottom. Contractors are now allowed, in almost all concrete construction work, to erect a centrally located tower where the concrete is taken from the mixer and elevated to a height necessary to chute it several hundred feet into the forms, making a very wet mix in order to deliver it without difficulty. In fact, they are allowed to do almost what they please with the concrete, just so long as they get it in place and the outer face looks smooth when the form is removed.

It has been my observation that the best concrete is mixed to a plastic consistency (which requires the amount of water to vary from time to time as the conditions of the materials and the weather may demand for a mix of this kind) and deposited into the form without breaking up the initial mix, after which it is worked into position around the reinforcing with a churning motion, thus bringing excess water to the surface, where it can be allowed to accumulate at one end of the form and removed before the concrete takes its initial set.

J. S. MORRISON,

District Engineer, Iowa State Highway Commission.
Ottumwa.

this effect is not fully recognized in practical work. The first four paragraphs of Mr. Johnson's proposed specifications will be accepted readily by the majority of engineers. His fifth clause, proposing to waste the lighter portions of the concrete, is equivalent to an admission that these troubles cannot be avoided by proper inspection, and does not strike at the root of the evil.

The responsibility for defective work such as Mr. Johnson describes rests primarily with the engineer in charge. If he permits the contract to be let without consideration of the methods to be used, especially the use of chutes with flat slopes, the inspector, no matter how competent, cannot control the water properly. If steep slopes are insisted upon by the engineer and a suitable proportion of mortar is provided in the mixture, excess water is not required, and no laitance or separation of liquid mortar need occur unless the inspector is careless or ignorant. It is futile to try to correct these abuses by wasting good material as Mr. Johnson proposes.

In building a large dam in Spain (Talarn dam, 270 ft. high above bedrock, 355,000 cu. yd. in dam proper) it was necessary to prove to a specially appointed commission of government engineers that the methods used, which followed good American practice in many respects, were sound and permissible in such a structure. As a result, careful investigations were made covering a very broad field and extending over a number of years. These tests, among other details, confirmed once more the fact that the best results are obtained with a reasonably plastic but not liquid mixture, and that any reduction of the slope of the chutes beyond $1\frac{3}{4}$:1 or 2:1 retards the hardening and causes a permanent diminution of strength, which becomes very considerable with the slopes often used to-day in concrete work in the United States.

Nevertheless, it was also shown that the surplus mortar which separates under certain conditions is often nearly as strong as the concrete itself. In one case at the beginning of the work, variations in the grading and the consequent use of too much water caused marked separation of the surplus mortar, but the final compressive strengths of the liquid mortar on the surface near the forms, of the nonplastic concrete under the chute and of the rather liquid concrete lying between were 3410, 4415 and 4170 lb. per square inch respectively, as compared with the minimum requirement of 2135 and the maximum calculated stress of 285 lb. per square inch. Evidently in this special case wasting this surplus mortar would have been wholly unnecessary, and this is true in many other cases where the excess of water used is not too great.

Laitance is of course extremely objectionable, but it occurs only under lax inspection and can instantly be distinguished from mortar by the appearance and feel. Its appearance in finished work proves carelessness on the part of the inspector.

The point which should be emphasized is this, that the engineer in responsible charge of construction work is primarily responsible for bad concrete. Any contractor, if allowed to do so, will use flat slopes and an excessive amount of water, as it is cheaper to place concrete which is excessively wet than that which is reasonably plastic but not liquid. It is important that the requirements in this matter should be fully under-

SIR: Probably all engineers will admit the injurious effect of using too much water in concrete even though

stood at the time of placing the contract. When the purchaser's engineer is ready to pay for proper methods and insists upon their use, the tendency to use an excessive amount of water will disappear at once. In the meantime any proposal to waste the surplus liquid mortar fails to insure good work, much less to remedy the evil.

A. W. K. BILLINGS,
New York City. Consulting Engineer.

SIR: The article entitled "Water the Chief Factor in the Making of Good Concrete" is in the opinion of the writer timely, interesting and important. He would, however, take exception to the suggested specification, item No. 5, which says, ". . . the top portion of the forms shall be removed throughout the entire length of the section to such depth as may be required by the engineer and . . ."

If the depth to which the forms are to be removed is limited to a few inches, the forms could be constructed so that the above specification could be complied with and not be seriously expensive. If, on the other hand, this depth varied, it would be rather a burdensome operation. Assume, for instance, that the forms are made of 10-in. plank laid horizontally, and the engineer directs that 4 in. of the top be removed.

It seems to the writer that the purpose of this suggestion can best be accomplished by providing for the continuous pouring of the concrete from the bottom to the top of the section. Of course this is not possible in all cases, but it is possible in many cases where it is not done.

W. C. BRIGGS,
Brooklyn. Civil Engineer.

SIR: The writer has read with a great deal of interest Mr. Johnson's article and desires to call to your attention his article as published in the *Engineering News*, May 22, 1913, on the effect of too much water in mixing concrete.

Mr. Johnson is absolutely right in stating that water is the chief factor in the making of good concrete. In most instances the method of placing the concrete necessitates the use of a sloppy or watery mix. One of the arguments of the contractor is that even if the concrete contains more water than necessary, nevertheless the factor of safety is great enough to give satisfactory results.

In order to secure an ideal mix of concrete, it is absolutely necessary that it shall be tamped. On many of the small jobs it is impossible to be strict with the specifications, because the expense of living up to them is too great. The percentage of water entering into a mix of concrete varies according to the character of crushed stone used. Furthermore, the temperature of the atmosphere is also an important factor in the percentage of water. A concrete mix might contain a larger percentage of water than necessary, and unless it is tamped it is not noticeable. The best way to overcome the placing of too much water in concrete is to require that all concrete be tamped. This permits a drier mix to be used, and the engineer can regulate the percentage of water by observation and eliminate the expense of constant measuring and fluctuation of the measurement due to atmospheric and other conditions.

In regard to the removing of laitance, this should,

under all circumstances, be done while the surface is setting. After concrete is once set it is impossible for laitance to be satisfactorily removed.

One of the best methods of eliminating the evils of poor concrete would be to have competent inspectors on the job—men who understand concrete not only from a practical but also from a theoretical standpoint, and also to carry on an educational campaign among the contractors, explaining to them that it is to their advantage to place the concrete properly.

Canton, Ohio. CHARLES J. ROBISON, C.E.

Motor-Truck Legislation

SIR: In reading over the article on "Rules Proposed to Control Motor Trucks in New Jersey" and your editorial of Oct. 28 on the same matter, it would seem that these rules are along the right lines. Perhaps some changes in some of the requirements in the proposed rules should be made.

One thing is certain: Some rules and regulations must be made if we are to preserve our streets and roads and make them of lasting value to commerce. Two questions are involved: First, shall we regulate the traffic to our roads as constructed, or, second, shall we regulate our roads to the present traffic and for future traffic?

Taking up the first phase of the questions, we have the fact that there are thousands of miles of paved streets or roads now constructed. If traffic greater than these pavements will stand should be allowed, the present pavements would have to be replaced with others strong enough to carry the increased traffic and loads—and at an expenditure of millions of dollars. On the other hand, if the traffic were regulated to the better class of pavements now constructed it would reduce the size of the load which might be transported in the first case, but by placing the load on eight or twelve wheels instead of four the same amount of tonnage could be carried without damage to the road surfaces. In other words, the bulk of the tonnage could be carried in trailers.

It is estimated that an auto truck can pull four times as much as the load on the truck, so that there would be an advantage in the use of trailers. The destructive effect on the pavements is much less in the rolling load in the trailer than the tractive force in the truck.

The limitation as to the load per inch of tire in connection with the size of wheel and speed seems to be reasonable. It does not seem, however, to be so necessary to limit the length of the vehicle as it is to limit the width. The length does not affect the pavement particularly, but the width does limit and reduce the amount of traffic a specified width of pavement can accommodate; and if a vehicle uses more than, say, 84 in. in width, it is encroaching upon another vehicle's right and should pay for it.

There is one class of traffic that will have to pass over the pavements of the Northwest in particular, and that is traction engines and similar machinery. Most of these machines are equipped with grouters, lugs, or bars to prevent slipping in soft soil. These are not detachable in most cases. These conditions would seem to necessitate the construction of a type of pavement not easily affected by this class of wheel traffic; other-

wise some temporary covering must be placed over the projection on the wheels to prevent damage.

From a careful study of the whole question it would seem wiser, more economical and better to regulate the traffic to the better class of pavements as now constructed.

ELLIS R. DUTTON,

Minneapolis, Minn.

Assistant City Engineer.

SIR: I have read with much interest the articles in the Engineering Record on "How Shall Motor Trucks Be Regulated to Conserve Highways?" I believe this is one of the subjects of greatest importance to highway officials. That we may take advantage of cheaper transportation, on the one hand, provisions must be made for motor-truck transportation. On the other hand, that there may not be an economic waste in the use and abuse of our present highways, some restrictions must be placed upon their operation. The exact nature of these restrictions must be the result of a compromise because of the many and various conditions influencing them.

That we may not retard or curb too much what will be a more economic development of our transportation facilities, much study and consideration must be given to the restrictions placed on this kind of transportation. With reference to this phase of the subject I am of the opinion that Rule 8 of the proposed New Jersey Rules and Regulations (see Engineering Record of Oct. 28, 1916, page 536), forbidding the use of but one trailer, should have some modification; also that the rubber-tire provision of the trailer is unwarranted.

The provision of Article V, requiring sealed governors on all commercial vehicles, is of doubtful justification. If it is necessary on commercial vehicles, why not on passenger vehicles? It would seem that there are more good reasons for making this provision apply to passenger vehicles than to commercial vehicles. In the former case it would also be a protection to human life—a "safety-first" provision, so to speak—while in the latter it would be mostly a commercial question. This is a very delicate subject, and I question very much the practicability of the universal enforcement of such a restriction.

The proposed provision in the New Jersey rules (Article V) for a graded license fee is a commendable one. Of all the complicated questions involved in determining a just tax it would seem that this is one of the most exact means of placing a tax in proportion to the service rendered. We can, to a very decided degree, take care of the economic question involved in the restrictions by the proper application of the graded fee. It might be made much more flexible than to apply just to a variable load.

Inclosed I am sending you a copy of the rules and regulations adopted by the Ohio State Highway Department about a year ago. These may be of some interest to you, although some of them are not up to date because we had to adopt such as had been previously enacted into laws, perhaps so long ago that they are antiquated.

A. H. HINKLE,

Deputy Highway Commissioner, Bureau of Maintenance and Repair.

Columbus, Ohio.

[Some of the provisions in the Ohio rules are as follows: Lugs, spikes, chains or other projections se-

riously destructive to the surface are prohibited. Twelve feet wide is the limit "unless said greater width will leave one-half the road free for passing vehicles." A maximum load of 3400 lb., including the weight of the vehicle, shall be carried over a gravel, macadam or stone road in a vehicle having a tire less than 3 in. wide. For wider tire widths the linear-inch load shall not exceed 600 lb. This is halved where the road is soft because of thawing weather or excessive rains. Trailers must track with the pulling vehicle. Written permission from the state highway commissioner must be obtained to move loads in excess of 15 tons. Speeds for motors carrying in excess of 4 tons, including the vehicle, shall not be greater than 15 miles per hour, and in excess of 8 tons, 6 miles for metal-tired vehicles and 12 miles for rubber or similar substance.—EDITOR.]

Standard Ottawa Sand Not Strong Enough for All Purposes

SIR: I wish to call attention to a misconception some engineers appear to have regarding standard Ottawa sand. The specifications of the American Society for Testing Materials require a natural sand from Ottawa, Ill., screened to pass a No. 20 and be retained on a No. 30 screen, and therefore, on account of its grading, it will give a relatively weak mortar or concrete with the usual proportions. In spite of this a great number of specifications require a sand developing a strength of only 75 or 100 per cent of that of standard Ottawa sand, and the writer remembers one instance, on reinforced concrete work, where only 50 per cent was specified.

On a contract recently let by this department a well-graded sand developing a strength of 150 per cent of that of standard Ottawa sand in 1:3 mortar was specified, and three sands accepted for this work gave an average of 167 per cent in tension and 200 per cent in compression.

In the writer's opinion, the generally accepted specifications might be improved by requiring the sand to develop a certain percentage of the strength of standard Ottawa sand without specifying the proportions, the proportion of furnishing this strength being used in determining the amount of cement to be used in the structure. The percentage required will be governed, of course, by the nature of the work in which the sand is to be used, and the contractor would benefit in saving of cement by furnishing an extra-good sand. A sand which could not furnish this strength at maximum density would, of course, be rejected. The tests for grading and composition would also be applied.

JOHN H. RYCKMAN,

Toronto, Ont.

Department of Works.

Los Angeles Publishes 3000 More Copies of Aqueduct Report

The Los Angeles Department of Public Service has published 3000 copies of the final report of the construction of the Los Angeles Aqueduct to meet demands for the volume which were received after the first edition had been distributed. The charge of \$1.95 prepaid is asserted to be less than the cost of production.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Pontoons Convey Concrete Used to Seal Cofferdam with Sand Bottom

SMALL PONTOONS were used to convey concrete buckets between the mixing plant and the tremie float in sealing the large cofferdam for government lock 1 on the Cape Fear River at Kings Bluff, N. C. Concrete seals were placed around piles on sand bottoms at this lock and at lock 2 (described in the Engineering Record of Sept. 9, 1916, page 325), which were able to withstand an upward pressure of 2000 lb. per square foot.

As outlined by Capt. C. S. Ridley, Corps of Engineers, U. S. Army, in *Professional Memoirs*, January-February, 1917, this type of construction, involving a steel cofferdam set close to the outlines of the completed lock and sealed with concrete, was adopted, in preference to an unsealed cofferdam of sufficient size not to be injured through movement of water and sand running into the pumped area, to avoid obstructing the narrow navigable channel of the river. With a view to depositing concrete for the seal through a tremie, the foundation piles, which cover the entire area inside each lock, were driven in rows across the cofferdam 4 ft. apart. At lock 1 the tremie barge, which mounted a derrick, used both to support the tremie and to dump the concrete buckets, was started at the

upstream end facing the wall of the cofferdam. While in this position the concrete buckets were lifted from the pontoons by a small unloading derrick, set on flat cars running on a track the length of the tremie barge and carried to the derrick at the other end. As soon as concreting had progressed the length of the tremie barge, it was turned around and the large derrick alone

used thereafter. The pontoons were handled from the mixer to the barge by lines wound on hand winches and rigged as shown in the sketch.

On account of the progress of the work it was necessary to place the seal at lock 1 during the winter, when high water prevailed. Therefore the concrete was deposited at depths ranging from 22 to 34 ft., and at times concreting was carried on with the

cofferdam completely flooded. The tremie was made up of 12-in. diameter cylindrical sections bolted together with flanges, and was provided with a hopper at the top and a short section at the bottom flared to 15-in. diameter. Work at lock 1 was carried on 24 hours a day, with only a few short delays for repairs, in order to have the seal monolithic.

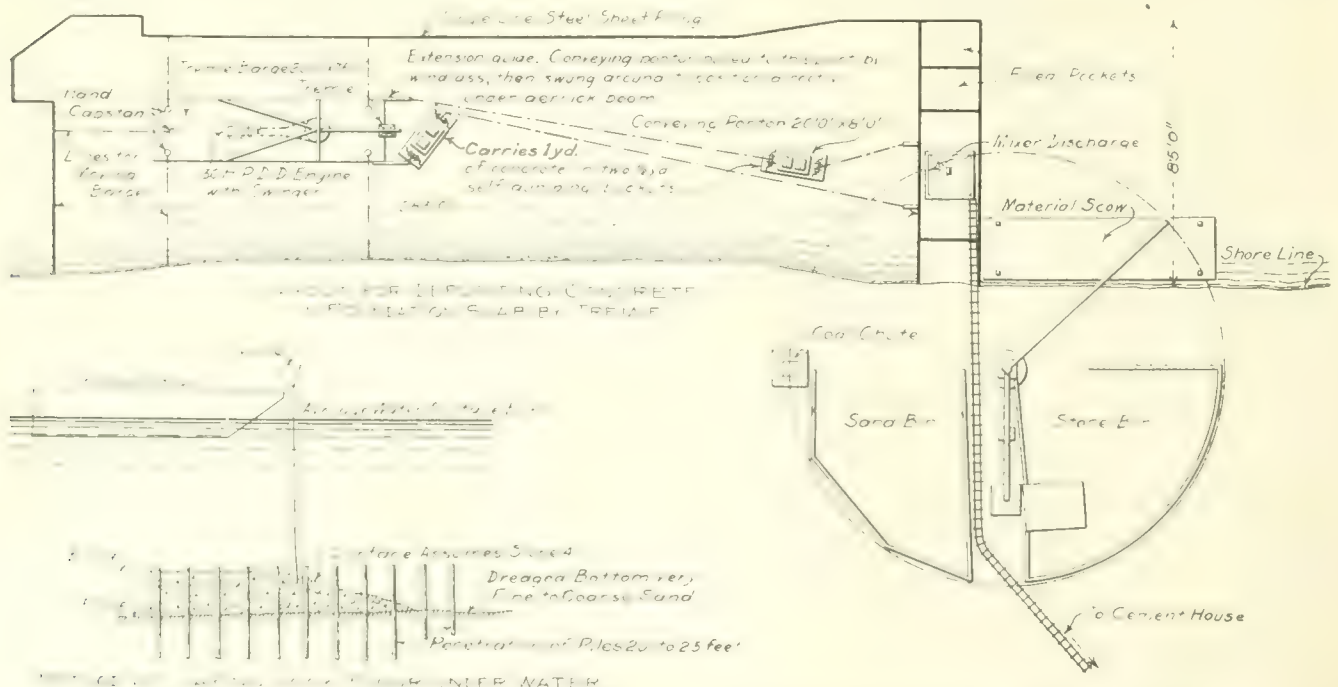
On starting, the tremie was set on the bottom and a batch of rather dry concrete with three or four sacks of cement dumped in. As the tremie tube held a little more than $\frac{1}{2}$ yd. of concrete, probably only a small part even of the first batch was "washed" by dropping

WITH THE COMING OF WINTER you construction men have a little time which you can call your own.

TAKE A FEW MINUTES of it to write us about that stunt you used last summer that had the "edge" on anything you'd seen before.

WE PAY FOR THESE ITEMS, and the many people who read them learn about you, your organization and your work.

ONLY A SHORT LETTER, with a sketch or one or two of those snapshots you took at the time, is needed. Send them to-day.



SMALL FLOATS, EACH HOLDING TWO CONCRETE BUCKETS, PULLED BY WINCH LINES BETWEEN MIXER AND TREMIE FLOAT

through water. After charging the tremie the concrete was kept in sight near the top of the tube. As each batch was dumped it filled the $\frac{1}{2}$ -yd. hopper at the top. The tremie would then be shifted along the front edge of the boat by swinging the boom, allowing the concrete to run out at the lower end until the hopper was empty. Movement was then stopped until the next batch was dumped in the hopper. When the tremie had been shifted the length of the front end of the barge, the barge itself was moved over by means of the lines indicated on the layout drawing. One trip across the cofferdam between each row of piles was sufficient to bring the concrete to the desired grade 6 ft. above the bottom. The concrete as deposited flattened out on a 4 to 1 slope, as shown in the section, resulting in long laps between the masses placed in succeeding rows, and avoiding undesirable vertical joints.

As the foundation piles had been driven a considera-

a matter of fact, the seal at lock 2 successfully withstood a head of 30 ft., although as actually placed it varied from 1 to 2 ft. thinner than that at lock 1.

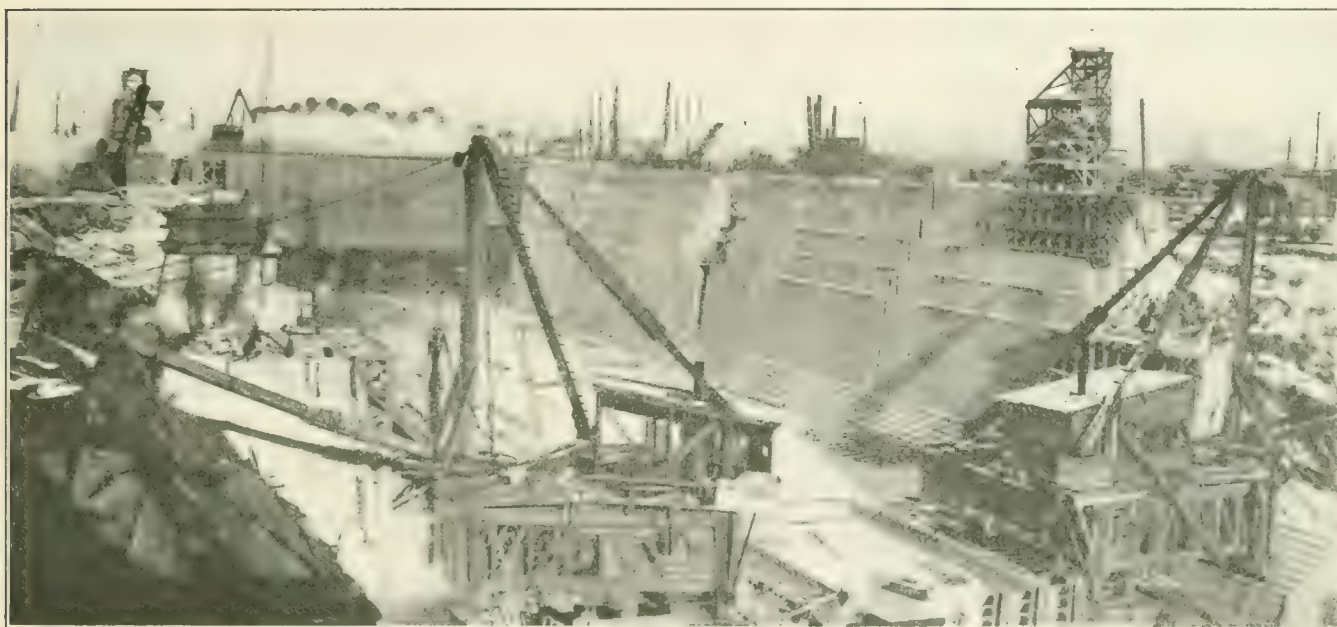
Construction on the Cape Fear River project has been carried on by government forces under the direction of Capt. C. S. Ridley, Corps of Engineers, U. S. Army.

Seat Gate Before Completion of Quebec Drydock to Reduce Pumping

By H. H. BRAUN

General Superintendent, M. P. & J. T. Davis, Quebec

ON NOVEMBER 18 the cofferdam at the outer end of the government drydock under construction at Quebec was flooded to reduce pumping charges, the steel caisson gate across the outer end of the drydock having been erected and closed. The gate was moved



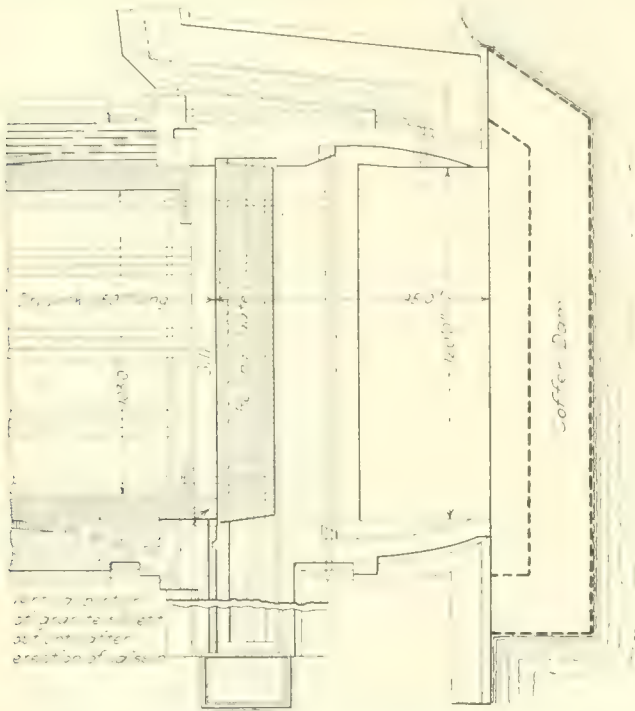
PUMPING GREATLY REDUCED FOR LARGE PART OF CONSTRUCTION BY CLOSING GATE AND FLOODING OUTER COFFER

ble distance below water with a follower, a few of them were found out of line; and occasionally in dragging the tremie across the cofferdam it would strike a pair of piles too close together to let it pass and be lifted off the bottom and lose its charge. This, however, produced no serious defects in the seal at either lock.

On account of the high water which prevailed during and after the concreting of the seals—it being impossible to pump the cofferdam at lock 1 for two months after the seal was finished—a layer of mud and scale was found on top of the concrete upon unwatering. When this was removed, however, the main body of the concrete was found to be in excellent condition. The slab proved practically watertight, but the pressure on it was sufficient to force water through the grain of the pine piles projecting above the concrete, so that the heads of these piles oozed water. The maximum pressure of 2000 lb. per square inch would be developed by a head of 32 ft. on the bottom of the seal with the coffer pumped dry. Of this pressure, about 900 lb. would be balanced by the weight of the concrete, leaving an upward pull of about $6\frac{1}{2}$ tons on each pile. As

$1\frac{1}{8}$ in. sidewise into place by the pressure of the water on its outer side.

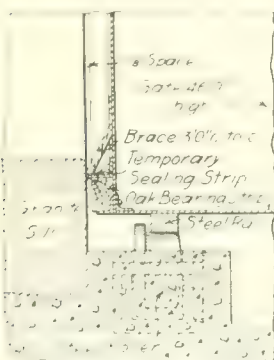
As shown in the sketches, this gate is 122 ft. long and 19 ft. 3 in. wide. It weighs, with ballast, 1500 tons. An oak bearing strip around the inside edges makes a watertight joint with granite sills in the bottom and the sides of the dock. This sill was first laid across the bottom and up one side of the dock in a recess left in the concrete. The caisson gate was then erected on its rollers, 6 ft. from its closed position and $1\frac{1}{8}$ in. back from contact with the sill. The oak strip across the bottom of the caisson was placed at the beginning of erection, and that up one side after completion. In order to provide space for placing the strip on the other end, it was necessary to leave out the sill at that side of the dock. After the erection work was finished, the caisson was jacked endwise into closed position and the strip on this end placed. With the $1\frac{1}{8}$ -in. clearance provided it was then possible to lay up the granite sill on this end, leaving the end of the dock closed except for the small distance by which the gate was out of contact with the sill. This work was completed considerably in advance of the construction



GATE ERECTED SIX FEET FROM CLOSED POSITION

inside the dock proper, so that the cofferdam could be dispensed with and the pumping charges practically eliminated for a good portion of the work.

While the gate was of course designed to move end wise, it was not intended to be moved sidewise, and the problem presented of overcoming the friction due to its 1500 ton weight in sliding it over on the rollers to contact with the sill was a serious one. It was decided not to attempt to move the gate by mechanical means, but to trust to the head of water on the outside to push it into contact after the cofferdam had been flooded. To prevent a large flow of water into the dock before the gate should move over, a soft pine sealing strip was inserted between the bearing strip and the granite sill and braced down as shown in the sketch. Care was



SEALING STRIP KEPT OUT WATER

taken to see that nothing got between the faces of the sill and the bearing strip. When the sluice gates in the cofferdam were opened and the space outside the gate filled to a considerable depth, the water pressure crushed the temporary ceiling strip and moved the gate over into contact. It was expected that when the water reached a sufficient height the gate would go over with a bump. This did not occur, however.

The movement was very gradual, and almost no water passed the temporary sealing strip during the process.

The drydock is being built for the Canadian government by M. P. & J. T. Davis, contractors, of Quebec, under the general direction of S. H. Woodard. The writer is in charge of construction as general superintendent. The caisson gate was built by the Dominion Bridge Company as subcontractor.

Battered Tops Cut Off Long Steel Sheet Piles Before Pulling

THE TOPS of the arch-web steel sheet piles driven, with several makes of sheeting hammers, in the deep cofferdam for the power plant at Beach Bottom, W. Va., described on page 144 of this issue, were battered in driving. When pulling was started with a gin-pole and an eight-part set of wire-rope falls, the piles not only pulled hard all the way up, but the interlock of the pile being pulled would be so badly bent in drawing it through the battered section of the pile next to it as to make the pile useless. After three or four pieces of sheeting had been withdrawn in this way, the oxy-acetylene outfit kept on the job for general use was put to work cutting off the tops of the piling. A straight cut was made all around the cofferdam, taking off the battered tops of the piles, which averaged about a foot in length. New pulling holes, one about 6 in. below the other, were burned in each pile. These holes were burned large enough to accommodate a 1½-in. pin. They are stated to have been a great improvement over the small holes usually provided. The arrangement of having one of them directly over the other also brought more of the web metal of the pile into play in pulling than was the case with two holes side by side. Where the pulling was very hard, long straps with a pin through each hole could be used, the pin which first took a strain stretching its hole slightly till the other pin came to a bearing. The plant is being built by the Foundation Company, for which H. B. Kelsey is superintendent under George R. Johnson, district manager.

Wayne County Intends to Build Wider Concrete Roads

Hereafter no concrete road in Wayne County, Michigan, will be built with a width less than 16 ft.—24 ft. including shoulders. This statement is from the annual report for 1915-16 of the board of county road commissioners headed by Edward N. Hines, chairman. Experience shows that immediately upon opening up a new concrete road traffic increases enormously as compared with what it was before. The report continues: "Not only is greater use made of the road by abutting dwellers, but people come miles from either side to use the concrete road in preference to the routes they have been accustomed to using. The roads therefore must be built, not with a view of accommodating the traffic they have been accustomed to bear, but to accommodate at least three times that traffic. Our roads attract traffic, and, with this increase, the tendency is toward greater speed, wider gage and heavier bodies, so we have decided that wherever feasible we will make the roads 18 ft. wide, of concrete, 26 ft. over all. Near Detroit we are going to increase the width to 20 ft. of concrete, 28 ft. over all." While this will add materially to the first cost, the report points out, it will prove a real economy in the end, as the cost of macadamizing and repairing the shoulders will be eliminated to a large extent. The statement is made that more money has been spent in the past few years on the shoulders of such roads as Woodward Avenue and Seven Mile Road than would have been paid for the first cost of building these thoroughfares 6 ft. wider of concrete.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Discuss Engineers' Part in Americanization

Meeting in New York City Under Auspices of Chamber of Commerce of U. S. A.

The engineers' part in Americanization—that is, the work of educating immigrants to American standards and instilling in them a love for American institutions—was discussed Jan. 19 in New York City at a dinner given by the Immigration Committee of the Chamber of Commerce of the United States of America and Mr. and Mrs. Vincent Astor at Mrs. Astor's home. In the absence of the chairman of the committee, Frank Trumbull, Gano Dunn, president of the J. G. White Engineering Corporation, presided.

Mr. Dunn, in opening the meeting, briefly stated the purpose of the discussion and explained the engineer's natural relation to Americanization work.

"Industrial Americanization is a part of the present-day movement toward the humanization of industry," he said. "It aims to make what is commonly called 'welfare work' not an exercise of the employers' paternalism but a legitimate part of business organization everywhere.

No Welfare Agreement

"There are now innumerable kinds of welfare work. But there is no agreement among American employers as to where the organization of the human side of industry really belongs. And there are absolutely no standards for it. What we need to do is to extend scientific methods to the human phases of industrial organization, and thus give welfare work a definite place and definite standards.

"The engineer, as the 'consulting mind' of industry, must be the leader in this work. It is he who determines the site of the plant and its construction. Inside the plant the engineer, again, has much to do with efficiency methods. No efficiency methods that are unrelated to the man in the plant can prosper permanently."

The various speakers, among whom were Dr. Ira N. Hollis, president of the American Society of Mechanical Engineers; Raymond B. Price, vice-president of the United States Rubber Company; Howard E. Coffin, and Michael I. Pupin, brought out the beneficial affect of cultivating the immigrant, teaching him English and showing him that America wishes to help, not to exploit him.

Dr. Hollis, speaking on behalf of the engineers, pledged their support for the movement and promised co-operation in any plans for furtherance of the work that the immigration committee might propose.

Plans for further work looking toward placing the matter more fully before engineers are not yet matured, but it is understood that the steps toward this end are to be taken shortly.

House Passes Building Bill

An omnibus public-building bill, which President Wilson is quoted as having said he would veto, was passed Jan. 19 by the House, 234 to 92. It carries \$38,000,000 for buildings, improvements or sites in cities and towns all over the country. The bill now goes to the Senate.

Action in the House followed a long and bitter debate, during which advocates of the measure defended it and opponents denounced it as "pork barrel" legislation.

While the bill carries a total of \$38,000,000, Chairman Clark of the Public Buildings Committee told the House that this would be reduced about \$6,000,000 by money returned to the Treasury through the sales of old sites and buildings.

President Wilson Urges Action on Power and Railroad Bills

During the last week President Wilson has made several visits to the Capitol to speed up the legislative program. In his address of Jan. 18 the President sought to effect arrangements whereby the water-power bill will be in presentable shape by March 4. He expressed the belief that the measure should be enacted into law before the close of the European war so as to permit the investment of capital in the development of water power. The principal differences of opinion are as to the methods by which power rights shall be granted and the amount the government shall be compelled to pay for return of concessions when a lease has expired.

The following day President Wilson placed special emphasis on the desirability of passing the railroad bills and again expressed his desire for quick action on the water-power bill.

Texas May Have License Law

Licensing of all highway, structural, hydraulic and sanitary engineers practicing in the state is provided for in a bill to be introduced in the legislature now in session at Austin, Tex. It is proposed to create a board of inspectors to hold examinations twice a year for examining engineers for the purpose of securing state licenses. A small fee will be charged for the examination.

Third Attempt to Block Chipewa Power Scheme Fails

Court at Toronto Upholds Previous Decision—Commission Had No Right to Divert Water

The third attempt to block the Chipewa power scheme of the Canadian Hydroelectric Power Commission shared the fate of the two earlier attempts when the First Divisional Appellate Court at Toronto Jan. 12 upheld the decision of Master-in-Chambers Cameron, which set aside the writ of the Electrical Development Company of Ontario, Limited, which claimed, among other things, that the hydroelectric commission had no right to divert the waters of the Niagara or Welland River for power generating purposes. The company asked for this declaration in face of legislation by the Provincial Parliament which gave the commission power under statutes to proceed with the scheme. The company also asserted that the lieutenant-governor-in-council had no power to authorize the commission to proceed, and that covenants in the agreement between the Queen Victoria Park Commissioners and the appellants' assignors were binding upon the lieutenant-governor-in-council notwithstanding these statutes. It also asked an injunction restraining the Hydroelectric Commission from acting under the statutes passed to provide for the Chipewa work.

Court's Decision

Chief Justice Sir William Meredith, in giving the decision of the court dismissing the appeal, described the action by the Electrical Development Company as a novel attempt to obtain judgment to restrain the province from carrying out the statutes of its own legislature. As compensation was provided for under the hydroelectric commission act, the assessment of damages by the method therein set out must form the only way in which the Crown could be proceeded against.

In the written judgment of the court, Mr. Justice Hodgins points out that the argument of the appellants is that the court is entitled and bound to make a declaration which should tie the hands of the executive of the province and define exactly the limits within which that executive could act.

It is stated that the case will be appealed.

Next Week — Market Reports

Niagara Power Bill in House

Exclusive right to divert water in the United States at Niagara Falls to produce and distribute hydroelectric energy is given to the Niagara Power Commission in a bill introduced into Congress Jan. 6. The bill provides for chartering the commission as a public corporation which will be governed by a board of three commissioners, which in turn will be appointed by the President with the approval of the Senate. Of the first commissioners one will serve for two years, one for four years and one for six years; and thereafter each commissioner will serve for six years. The salary of the chairman of the commission will be \$6,500 and of the other two members \$6,000 per year.

The bill provides for the distribution of electric energy to municipalities and consumers convenient to the works and lines except to those who are willing to assume the cost of distribution. It is further provided that the commission shall pay into the Treasury of the United States one dollar per annual horsepower generated, that no taxes shall be levied upon the commission by any state and that the commission be allowed to contract with one or more of the concerns now generating electric energy at the Falls at a rate not exceeding \$15 per annual horsepower. The bill provides a fine of not more than \$5,000 for the generation of current other than that by the commission and provides that the commission may authorize such diversion for not more than 5 years at \$75 per second-foot.

Road Builders Convene February 5 in Boston

The program for the seventh American good-roads congress, to be held Feb. 5 to 9, in the Mechanics Building, Boston, under the auspices of the American Road Builders' Association, includes papers on construction and maintenance of all kinds of roads as well as equipment. Traffic and its regulation and effect on design, construction and maintenance will also be discussed.

The policy and program practised by the government in road construction under new federal-aid laws will be explained by Logan Waller Page, director, U. S. Office of Public Roads and Rural Engineering. Highway engineering education is the subject on which T. R. Agg, professor of highway engineering, Iowa State College, will speak. H. E. Breed, first deputy commissioner, New York State Highway Commission, will outline the best practice in concrete road construction. Recent practice in granite-block pavements will be discussed by William H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, while wood-block pavements will be the subject discussed by Ellis R. Dutton, assistant city engineer, Minneapolis. F. R. Williams, paving engineer, Cleveland, will present a paper on best practice in brick-pavement construction.

D. B. Goodsell, assistant engineer,

Department of Public Works of the Borough of Manhattan, New York City, will speak on traffic census, its application to the design of roadways, selection of pavements and traffic regulation. Earth and gravel-road maintenance is the subject on which R. L. Morrison, professor of highway engineering, Agricultural and Mechanical College of Texas, will talk. In the evening of Feb. 5 the officers of the American Road Builders' Association will tender a formal reception to the exhibitors in the convention hall. The first session of the congress will be called to order at eleven o'clock Tuesday morning, Feb. 6. Governor S. W. McCall of Massachusetts and Mayor James M. Curley of Boston will welcome the delegates to the state and city respectively. Other addresses will be made by Col. William D. Sohler, chairman of the Massachusetts Highway Commission; Charles F. Weid, president of the Boston Chamber of Commerce, and George W. McNear, president of the Bay State Automobile Association.

A particularly interesting feature of the convention will be the question box. Questions to be discussed must be handed in at the registration booth not later than noon Wednesday, Feb. 7.

On Tuesday evening, at 7.30, an entertainment and smoker will be given by the Massachusetts Highway Association at Convention Hall, corner of Garrison and St. Botolph Streets. The annual dinner of the association will be held Wednesday evening at the Hotel Copley-Plaza. The reports of committees will be presented at 4.30 Thursday, Feb. 8.

Plans to End Railway Strikes

At a meeting Jan. 21 in New York City, Oscar S. Straus of the Public Service Commission announced plans for the establishment of two or more wage boards to have jurisdiction, with the commission, over labor disputes involving public utilities of the city. The suggested plan contemplates the creation of boards composed of an equal representation of employers and employees which shall endeavor to settle disputes. Failing in this, the boards shall submit the controversy to the commission, which shall have final jurisdiction. It is expected that the plan will require the men to remain at work and forbid them from being locked out.

To Organize Chinese-American Chamber of Commerce in Chicago

Steps were taken Jan. 17 to organize a Chinese-American Chamber of Commerce in Chicago with the object of promoting the development of direct trade relations between American manufacturers and China. John J. Arnold, manager of the foreign department of the First National Bank, was selected as temporary chairman. The principal speaker was Julian H. Arnold, commercial attaché of the Bureau of Foreign and Domestic Commerce, stationed at Peking, China.

Waterworks Decision Affects Pennsylvania Boroughs

The right to construct and operate a municipal water plant was granted to Ringtown Borough, Schuylkill County, Pennsylvania, in an opinion given Jan. 9 by the Public Service Commission of Pennsylvania. The decision affects future municipal waterworks throughout the state. The opinion, by Commissioner Alcorn, points out that the commission cannot agree to extend the non-competitive principle in public-utility matters to the detriment of the public.

The Ringtown Spring Water Supply Company protested against the granting of a certificate of public convenience to the borough on the ground that it was already furnishing the inhabitants with an adequate supply of water at reasonable rates, and that there was no necessity for the borough to construct and operate waterworks for the same purpose.

The commission, however, holds that on evidence heard at the public hearing the borough had shown that the Ringtown company was not furnishing a proper water supply for domestic, commercial and fire purposes. Consequently the town should be permitted to construct and operate a municipal water plant. Commissioner Alcorn in discussing the non-competitive principle says:

"We cannot agree to extend the non-competitive principle to the hurt of the public. It is a theory that can be supported only on the ground that it is in the public interest. The probability of relief from the present water-supply agency is hopeless."

In November, 1915, the electors of Ringtown voted in favor of a bond issue for establishing the proposed waterworks and laying of mains. These bonds have been issued and plans for the work have been prepared. Most of the bonds are held by residents of the borough.

Garbage Expert Recommended for City of Cleveland

A report on the collection and disposal of garbage in Cleveland by a special committee of the city council calls for the employment of a sanitary engineer "to work out the most economical and sanitary method of collecting and disposing of Cleveland's wastes." Among other recommendations, which were made after numerous meetings with a subcommittee of the Chamber of Commerce, with city officials, I. S. Osborn, R. Winthrop Pratt and C. O. Bartlett, are: That the householders be educated in the proper method of disposing of waste and the forcing of them to comply with the law; that a regular schedule be maintained for the collection of all waste; that a standard type of receptacle be required for rubbish, and that the dumps have watchmen stationed on them at all hours and that the owners of private dumps be required to employ watchmen when filling takes any length of time.

Oregon Irrigationists Discuss Legislative Aid

The Oregon Irrigation Congress held its sixth annual meeting in Portland this month, with an attendance of about 200. A discussion of legislative problems affecting irrigationists held a prominent place in the deliberations. Strong criticism of present conditions on some projects was voiced. A set of resolutions, adopted without a dissenting voice, embodied recommendations for changes in legislation and methods of financing which it was believed would greatly improve conditions.

It was recommended that a special committee be appointed to redraft the irrigation district laws, and that suitable legislation be urged upon the state legislature. A resolution was adopted declaring the irrigation district as the best plan for the operation, maintenance and construction of irrigation projects and recommending that all irrigation projects in Oregon adopt the district plan. It was desired that there

ready sale at prices near their real value.

L. M. Rice of Seattle pointed out that the civil engineer who helps to build up irrigation projects has more responsibility than he who runs curves and makes cost estimates. It is the province and duty of the engineer, he said, to see that everything smacking of speculation is eliminated, because no project will be a success unless it results in the actual settlement of home builders and the actual production of crops under irrigation.

Officers elected for the ensuing year were as follows: J. T. Hinkle, president; H. W. Gard, vice-president, and F. N. Wallace, secretary.

\$24,850,000 Asked for Pennsylvania Roads

The budget of the Pennsylvania State Highway Department for 1917 and 1918, just made public, appropriates \$24,850,000. The requested appropriation carries an item of \$6,000,000

\$250,000 per year for the purchase of turnpikes and toll bridges—this money to be spent only on an even basis, the local authorities in all cases paying 50 per cent of the cost of freeing toll roads and bridges.

In addition to the above, \$3,000,000 per year is assigned for necessary legislation to make available the automobile license fees for state highway maintenance, and \$1,350,000 for a deficit in the township road bonus.

Colorado Considering New Highway Laws

Centralization of responsibility is the main idea in the draft of a proposed highway law which the Colorado survey committee of state affairs has presented to the state legislature. The new plan has two fundamental objects—first, the development and extension of highways in accordance with a preconceived and harmonious scheme of expansion and upkeep which shall keep pace with the growth of the state, and second, the wise and economical ex-

Walls and Roof of New Garage Collapse Without Warning

ON JAN. 19 the recently completed garage belonging to Charles E. Lair, of Gloversville, N. Y., collapsed suddenly. Fortunately, only one man was in the building, and he was able to escape with minor bruises. The building is 132 ft. long and varies in width from 23 ft. in the rear to 62 ft. in the front. Six wooden trusses carried a shingle roof

and spanned the full distance between the side walls. These walls were built of 8-in. hollow concrete blocks 8 in. thick and 10 ft. high above the footing course. According to information, with photographs, furnished by H. J. Hanmer, the city engineer, the roof trusses rested on the 8-in. side walls without supporting pilasters.



be embodied in Oregon laws that feature of the California statutes which provided for the certification of irrigation district bonds by a commission consisting of the state engineer, attorney-general and the superintendent of banks.

It was pointed out that irrigation districts should receive assistance in the form of guarantees of interest on bonds either by state or federal authorities, so that when the securities are placed on the market there would be a

per year for state highway construction; \$1,000,000 per year for highway construction within the limits of the boroughs where the state highway route is improved—the money to be allotted to the various counties on a mileage basis, final decision as to the expenditure to be left to the highway commissioner and any unexpended balance in each county to be available for use on routes outside of boroughs in the county; \$1,500,000 per year for state-aid construction and maintenance, and

penditure of funds for road work. The aim is not to destroy present forces but to unify and concentrate them for better results.

The proposed bill creates a state highway department to be headed by five commissioners who shall appoint a state highway commissioner. The commissioner is to prepare plans and let contracts on state highways and will have the right to prescribe the qualifications of the county highway engineers and district road superintendents.

Reject \$11,000,000 Flood Prevention Plan.

The flood protection plan submitted by Alvord & Burdick, contemplating the expenditure of \$11,000,000 in Franklin County, Ohio, and adjacent counties, has been formally rejected by the Franklin County Court of Common Pleas at Columbus. The court considered only the financial feasibility of the plan, and did not attempt to pass on the engineering problems. The conservancy board will, therefore, be temporarily prevented from further efforts toward flood prevention.

The hearing was begun Dec. 6, 1916, at which time the legal objection was raised as to the right of the district to enlarge by taking in additional territory to protect Delaware, Chillicothe, and the farm lands between these cities, on the bottoms of the Olentangy and Scioto Rivers. The court, at a later hearing, ruled that the district could not enlarge, as to do so at a hearing before judges of Franklin County only would be illegal. It is said that this decision is going to make it practically impossible to organize conservancy districts that afford more than distinctly local protection.

Big Pipe-Line Contract Calls for Half Mile of Completed Line Per Day

What is probably the largest irrigation pipe-line contract ever let has just been awarded to Bent Brothers, of Los Angeles, Specialists in this type of construction. The work consists of 125 miles of concrete pipe, mostly 16 in., to be made and laid on the lands of the N. & E. J. Allen Company in Fresno County during 1917. The system will, it is said, be as perfect in quality and detail as possible, and will include turnout boxes, weirs, standpipes, "K-T" fittings and the Hydrometric Company's "Reliance" irrigation meters. The pipe will all be precast in 2½-ft. sections. The contract requires approximately one-half-mile of completed line per day.

Michigan Engineers Propose License Law

At the annual meeting Jan. 16, 17 and 18 of the Michigan Engineering Society more than 180 members were present. The place of the convention was Saginaw, Mich. Licensing of civil engineers was the subject that received the greatest discussion and the society was unanimous in its adoption of a tentative bill, drafted for transmission to the state legislature now in session, by which engineers that qualify before a state board of examiners shall be "admitted to practice" in the state. The paper provides only for civil engineers in general, although it has separate clauses for land surveyors, topographic surveyors, sanitary engineers, hydraulic engineers and structural engineers. The bill, if passed, will allow the engineer to plan and erect buildings, a thing he is now prevented

from doing by the architects' license law.

The following officers were elected: President, Theodore O. Williams, surveyor of Grand Rapids; vice-president, Edward D. Rich, state sanitary engineer, Lansing; treasurer, Arthur J. Decker, associate professor of sanitary engineering, University of Michigan; secretary, William W. Cox, deputy highway commissioner, Kalamazoo.

Berkeley Completes Yard for Street Department

Berkeley, Cal., has just completed the first unit of building construction at the site of the new corporation yard at Allston Way and West Street on the main line of the Atchison, Topeka & Santa Fé Railway, and will move from the old yard to the new location without delay, according to information received from Tom A. Bither, assistant superintendent of streets. The old

may be received direct from the cars, doing away with the intermediate hauling, which is now necessary. Further additions provide for more sheds for housing equipment to be purchased.

Signs Niagara Power Bill

President Wilson, on Jan. 19, signed the Niagara power bill authorizing the diversion of 20,000 sec.-ft. of water from the American falls for power purposes. The granting of licenses for the use of the water, and other regulations, are placed in the hands of the Secretary of War.

Consider \$2,500,000 Bond Issue

Ways and means of floating a \$2,500,000 bond issue to carry out improvements on both sides of the international border were discussed at a recent meeting of the directors of the Imperial Valley Irrigation District and officers of the water companies of the valley.



NEW CORPORATION YARD AT BERKELEY, CAL.

yard, which will be abandoned and the site used for a public park, is made up of a collection of ramshackle sheds, including an old jail house and several old fire-apparatus sheds, relics of the fire-department days.

Complete motorization of the equipment of the Bureau of Streets will follow the moving to new quarters. The economy of motor equipment was clearly demonstrated last year, when a 3-ton auto truck replaced five two-horse teams formerly required to do the same amount of hauling. With the motorization comes the necessity for adequate repair equipment. At the old location, with almost complete lack of mechanical equipment, repairs were made with the greatest difficulty, and it was only because the motor equipment was new and the repairs were light that the work could be carried on.

At the new quarters a large machine shop has been provided, which will be equipped with modern machine tools and will be able to take care not only of repairs for the Department of Streets, but also for the fire, police and park departments.

Special architectural study was given the buildings just completed, both in grouping and design, to insure a yard which would not detract from the value of surrounding property. The site is located in the center of the city and on a main-line railroad, by means of which materials for the construction and maintenance of streets and sewers

The second report, recently made, detailed the improvements. It advocated building a new intake, channel dredging from the new structure to the Alamo channel, and the erection of many structures north of the boundary.

To Investigate Cleveland Traffic Conditions

The city council of Cleveland has directed the street railway committee to investigate questions relating to a downtown subway terminal for street cars, with special reference to location of terminals, whether the city can construct subway terminals, and whether a private company should be allowed to build and operate such terminals. The report will be presented as soon as possible.

Calls Drainage of Everglades Florida's Chief Problem

Drainage of the Florida Everglades was characterized as the state's chief problem by Governor Sidney J. Catts in his recent inaugural address. The first step in that direction, he said, would be an awakening of the people to the greatness of the project, people living in other sections of the state not being properly in sympathy with it. After that, he said, it would be necessary to float \$3,000,000 worth of bonds, and then an equivalent amount, but the result, he thought, would be "the richest land on earth."

Engineering Society Activities

Florida Engineering Society will hold its first annual meeting Feb. 2 and 3 in Tampa. The meeting will be held in the council chamber, City Hall, and the headquarters will be at the Hillsborough Hotel.

American Institute of Consulting Engineers, at its annual meeting Jan. 15, elected the following members to the council: Gardner S. Williams, A. M. Hunt, Lewis B. Stillwell and William J. Wilgus.

Nebraska Association of Members of the American Society of Civil Engineers was organized Jan. 5 at Lincoln. The following officers were elected: President, Frank C. Darrow, Lincoln, engineer maintenance-of-way of the Chicago, Burlington & Quincy Railroad; vice-presidents, Adna Dobson, city engineer of Lincoln, and George L. Campen, Omaha, consulting engineer; secretary and treasurer, Homer V. Knouse, Omaha, constructing engineer, Metropolitan Water District of Omaha. The Legislative Advisory Committee is the name of a body formed at the first meeting which has for its purpose the advising of the State legislators on engineering subjects. William Grant, of Lincoln, was made chairman of the committee. The next meeting of the association will be held Feb. 3 at Lincoln.

American Association of Engineers, board of directors, has appointed N. M. Stineman, building engineer, Chicago, Milwaukee & St. Paul Railway, to fill the directorship left vacant by the resignation of T. B. Lambert. The Gary chapter reports the election Jan. 12 of its temporary president and secretary, G. C. Dooce and W. H. Sallwasser, respectively, as permanent officers for the ensuing year.

Iowa Engineering Society will hold its annual meeting Feb. 21-23 at Iowa State College, Ames.

Minnesota Surveyors' and Engineers' Society will hold its annual meeting Feb. 7-9 at the Hotel Radisson, Minneapolis.

Indiana Sanitary and Water Supply Association's annual meeting will be held Feb. 14 and 15 at the Claypool Hotel, Indianapolis.

Ohio Engineering Society will hold its annual meeting in Columbus at the State University Jan. 31 and Feb. 1 and 2.

Western Society of Engineers was addressed Jan. 15 by T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, on "Modern Sewage-Disposal Methods." He was followed by Prof. Edward Bartow, director of the Illinois State Water Survey, who detailed his experiences with activated sludge at Urbana. The hydraulic, sanitary and municipal section, under whose auspices the meeting was held, elected the following officers for the ensuing

year: Chairman, Dabney H. Maury; vice-chairman, H. E. Hudson; directors, W. T. Barnes and Murray Blanchard. These officers, with W. W. DeBerard, the retiring chairman, form the executive committee of the section.

Engineering Society of Wisconsin will hold its annual convention Feb. 15 and 16 at Madison. Among those on the preliminary program are Prof. J. G. D. Mack, Fred G. Simmons, Prof. C. I. Corp, N. W. Withey, George H. Randall, F. A. Vaughn, W. T. Blackburn, Prof. George R. Bascom, H. E. Smith, H. V. Tennant and Prof. W. S. Kinne.

Engineering Society of York, Pa., at its recent annual meeting elected the following officers to serve for 1917: President, George A. Jessop; vice-president, Chauncey D. Bond; secretary, M. Haller Frey, Polack Building; treasurer, Harold A. Russel; directors, W. W. Birnstock, Griffith S. Amies, Harry W. Motter and officers.

Kansas Engineering Society held its annual meeting Jan. 16 and 17 in Topeka. The relation of the society to electrical, mechanical and railroad engineers and to architects was discussed in four separate papers. To publicity and the question of how to enlarge the membership were devoted two papers and a committee report. Road and highway bridge problems also were treated.

Iowa State Drainage Association will meet Feb. 20 and 21 in Fort Dodge.

What Engineers and Contractors Are Doing

F. J. STIMSON, superintendent of the Zanesville division of the Pennsylvania Lines West of Pittsburgh, has been transferred to the superintendency of the Richmond division. Mr. Stimson entered the service of the Grand Rapids & Indiana Railway in November, 1888, as clerk in the office of the claim and timber agent. He went into the field as rodman in the following year and continued in that position on various surveys and construction work until June, 1890, when he engaged in railroad surveys, maintenance of way and tunnel construction work in the southwest. In March, 1893, he returned to the service of the Grand Rapids & Indiana Railway as assistant roadmaster and was promoted to division engineer of the northern division in January, 1904. In July, 1915, Mr. Stimson was appointed superintendent of the Zanesville division.

W. A. COWAN, formerly division engineer of the Ontario division of the Transcontinental Railway, has been appointed acting general superintendent, owing to the temporary absence of F. P. Brady.

HAROLD A. RANDS, of Oregon City, Ore., recently accepted a position with the Alaskan Engineering Commission and sailed for Fairbanks,

Alaska. Mr. Rands was chairman of the Oregon City Board of Water Commissioners, and was engineer in charge of construction of the South Fork pipe line which brings mountain water to Oregon City. He described this work in the Engineering Record of Dec. 9, 1916, page 700.

W. C. WHITNALL has been appointed city engineer and water superintendent of Auburn, Wash.

D. M. MAWHINNEY, formerly with the Winnipeg, Selkirk & Lake Winnipeg Railway, has been appointed engineer of the municipality of Rockwood, Man.

ALBERT T. CANFIELD has resigned from the employ of the Kansas City Stock Yards Company to go with the engineering department of the Union Pacific Railroad at Omaha.

GULICK-HENDERSON COMPANY, consulting and inspecting engineers, announce the removal and consolidation of their general offices to 13-21 Park Row, New York City.

CHARLES E. EATON, consulting engineer, of Watertown, N. Y., has removed his office to the New Sherman Building. Mr. Eaton will continue to specialize in the designing and planning of paper, pulp and fiber mills, and hydroelectric and steam power developments.

HIGGINS & GREENWOOD, engineers and architects, of New York City, have removed their offices to the City Investing Building.

J. R. MORRISON has opened offices at the White Building, Seattle, and will engage in general engineering practice. Mr. Morrison was formerly connected with the engineering department of King County, Washington.

LORENZ A. DITHMER, of Hailey, Idaho, has been elected county engineer of Blaine County.

C. E. CROWNOVER, manager of storage construction for the Yakima irrigation project, U. S. Reclamation Service, recently removed his office to North Yakima, Wash., to organize his force for the construction of the \$2,000,000 irrigation dam at McAllister Meadows, 40 miles from Naches City. This year's work will be devoted to the construction of necessary buildings and of a 1600-ft. outlet tunnel.

R. L. CAVANAUGH has been reappointed city engineer of North Bend, Ore.

FRED C. CRAMER, of Kelso, Wash., has succeeded R. C. Westwick as county engineer of Cowlitz County. Mr. Cramer will be located at Kalama, the county seat.

FRANK D. GORE, of Port Orchard, Wash., has become county engineer of Kitsap County, succeeding S. H. Berry.

CHARLES L. KINNEY has succeeded Albert A. Reith as county engineer of Elkhart County, Indiana, with

office at Goshen. During the last twenty years Mr. Kinney served as city engineer of Elkhart and Goshen, and also as bridge engineer for the Toledo & Western Railroad. Mr. Reith has formed the Reith Construction Company, with headquarters at Goshen. The new company will operate in all lines of construction throughout the state.

J. R. BAYLIS has been appointed bacteriologist of the Montebello filters, Baltimore Water Department. Mr. Baylis, who left a position as manager of the Jackson (Miss.) waterworks, where he had charge of construction of the filter plant, has had a broad experience in municipal work throughout the South. Since 1912 he has been connected with the firm of Kirkpatrick, Culley, McCorkle & Baylis, consulting engineers.

JESSE K. GIESEY has been made a member of the firm of Fuller & McClintock, consulting engineers of New York City. Mr. Giesey was graduated from Rensselaer Polytechnic Institute in 1904. He was a member of the staff of Hering & Fuller from 1904 to 1911 and assistant engineer with Hering & Gregory from 1911 to 1914. For the last two and one-half years he has been in charge of the construction of the outfall sewer, pumping station and sewage-treatment works at York, Pa.

FRED E. JOEKEL, recently appointed deck officer of the U. S. S. Hydrographer, is engaged in making a re-survey of the Gulf Coast from the Mississippi delta to Mobile Bay. Previous to this appointment Mr. Joekel held the position of field and office draftsman with the Texas Power & Light Company, of Dallas, Tex.

R. C. NAGLE has resigned his position with Albert Kahn and will go to Japan for the Trussed Concrete Steel Company.

T. C. DESMOND & COMPANY, INC., engineers and contractors, 110 West 34th St., New York city, announce the incorporation of their business for the purpose of undertaking engineering and construction contracts of all descriptions. Thomas C. Desmond has been elected president of the company.

EDWARD C. SHERMAN, consulting engineer, of Boston, will on Feb. 1 take up duties as designing engineer, Bureau of Yards and Docks, Navy Department, Washington. Mr. Sherman is a native of Kingston, Mass., and was graduated from the Massachusetts Institute of Technology in 1898. After two months as transitman with the Massachusetts Topographical Survey, he spent four months with the U. S. Board of Engineers on Deep Waterways as rodman. That was followed by his employment as draftsman in the office of the city engineer of Boston. From 1899 to 1902 he was engaged on work for the Cambridge Bridge Commission, being promoted to assistant engineer in the latter year. From 1903 to 1909 Mr. Sherman was assistant

and later division engineer with the Charles River Basin Commission, and from 1909 to 1911 he was designing engineer for the Isthmian Canal Commission. Returning to Boston in 1911, Mr. Sherman engaged in private practice. He was retained as consulting engineer for the Merrimack Valley Waterways Board. In 1915 he formed a partnership with L. K. Rourke under the firm name of Rourke & Sherman. Mr. Sherman has been editor of the *Journal of the Boston Society of Civil Engineers* since its inception in 1914.

COL. THOMAS H. REES, Corps of Engineers, U. S. A., who has been stationed in San Francisco since 1911, has been assigned to the third regiment of engineers in the Philippines and will leave San Francisco on Feb. 5. Colonel Rees has been serving as department engineer of the western department and district engineer in charge of the first and second San Francisco engineering districts. He has also been chairman of the California Debris Commission. He will be succeeded by Col. Edward Burr, Corps of Engineers, U. S. A., who is now department and district engineer at Manila.

GEORGE B. DUBOIS, formerly with the International Pulp Company as efficiency engineer, has taken a position with the Compania de Minerales y Metales, S. A. He will be employed as location engineer on some proposed lines in Mexico.

E. B. YOUNGMAN has resigned as city engineer of Hazleton, Pa., to become chief of the coal and fuel department of the Harwood Electric Company.

BECKMAN AND LINDEN ENGINEERING CORPORATION has been incorporated with offices in the Balboa Building, San Francisco. The partners are J. W. Beckman, formerly with the Great Western Power Company, and H. E. Linden, of the Southern Sierras Power Company. The firm will carry on consulting and development work in civil, electrical, metallurgical and chemical engineering. Its activities will embrace investigations of the natural resources adjacent to existing or prospective power developments with a view to developing new industrial uses of power. Investigation of hydroelectric developments, complete designing and construction of power projects are also included in the firm's work. The company is also prepared to finance prospective developments. Mr. Beckman, following a number of years' experience in metallurgical and chemical industrial work in Europe, was successively associated with the research laboratories of the General Electric Company, the American Cyanamide Company, the Aluminum Company of America, the Great Western Electro-Chemical Company, and the Great Western Power Company. By the last named company he is retained in a consulting capacity. Mr. Linden's activities in electrical engineering and hydroelectric development embrace a

term of 12 years with the Sprague Electric Company, the Stone & Webster Engineering Corporation, and recently with the Southern Sierras Power Company.

Obituary Notes

GEORGE A. H. MOULD, civil engineer, well known in the structural field, died last Sunday at his home in New York City. He was born in 1864 at Kingston, Jamaica, West Indies. His first engineering work was with the Jamaica Department of Public Works, with which he became associated in 1879. Mr. Mould went to New York City in 1900 to enter the employ of Milliken Brothers. He later had charge for that firm of much important construction in Havana and in South Africa. His most recent work was for C. T. Wills, general contractor, of New York City.

MICHAEL RABBITT, president and founder of the M. Rabbitt & Sons Company, Toledo, died Jan. 8.

WILLIAM H. HEDGES, a pioneer Chicagoan and for 36 years an employee of the city, died Jan. 15. He was plainsman, scout, railroad constructor, city engineer and adopted member of an Indian tribe. He retired in April, 1915, after 25 years of continuous service as grade superintendent in the city engineer's office. In 1856 Mr. Hedges went to Canada to make a survey for the Great Western Railway. After that work was completed he went to Iowa as chief engineer for the Dubuque & Anamosa Railway, and while there had charge of the work of draining swamp lands in the southwestern part of the state. He took part in the gold rush across the plains to Pike's Peak, but returned shortly to Chicago, where he made the original survey of the harbor for the government. In 1865 he entered the employ of the city and made the original survey with the view to widening the river. At the time of the great fire, when all public records of city surveys were destroyed except the private set of notes that Mr. Hedges had saved, he turned his notes over to the city, scorning the money offered him, declaring that in time of stress his services to the public could not be measured in dollars. In 1879 he again heard the call of the West and went to the Dakotas as scout and topographical engineer for the Chicago & North Western Railway with Mr. Blunt, a close friend, as chief engineer. He staked out a claim among the hostile Sioux and settled 80 miles from neighbors or railroads. Upon his return to Chicago he resumed his old position in the engineering department. Among the things which he accomplished for the city was the establishment of a uniform city datum. He made the preliminary survey for Lincoln Park and had charge of the construction of many sewers.

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Concrete and Road Number

THIS issue, appearing just before the annual meetings of the American Concrete Institute and of the American Road Builders' Association, with their accompanying exhibitions of materials and machinery, is devoted almost exclusively to articles on concrete and road work. Upon the subject of highways, it has been the aim to cover the several types of pavement now in general use. The reader will find articles on sheet asphalt for resurfacing old macadam, brick upon concrete foundation, methods of filling joints in granite block and the paving of the main business streets of a New Jersey town with concrete. The economics of highways is accounted for by an article describing a business basis for the selection of road types. A better understanding of these principles would do much to reduce the present enormous waste of money expended on highway construction. Then, too, there is an account of what the Massachusetts Highway Commission accomplished last year. So much for the highway articles. For the concrete engineer and contractor there is a wealth of material—a huge waterfront structure at Hoboken, one of the largest in the country; a concrete coal-storage pit; a munitions plant covering 11 acres and completed on schedule time; a concrete bridge of artistic design; structures of the Boston subway which received special treatment on their surfaces. But why continue? The pages which follow are the best evidence that the Engineering Record realizes that this is the week of the road builder and of the concrete engineer.

Acceptance Day

THE closing paragraph of Mr. Bentley's article, on page 184 of this issue, carries a suggestion that is worth while passing on to other communities. The paving of the main business streets at Lakewood, N. J., was made the occasion of community rejoicing. Of course this is impossible with every piece of engineering work successfully completed, but where a main artery of a town or an important work—a new water supply or a bridge—is involved, opportunity is afforded to link up in the minds of the citizens the engineer's relation to the welfare of the community. This has been done in the case of monumental works constructed for big cities, but is rather infrequent in connection with the smaller construction. The promotion of the idea must originate with the engineer. He will find no difficulty in securing the co-operation of civic organizations.

Another View of Grade Separation

UNDER LAWS that throw the whole cost of grade-crossing elimination on the railroads it is easy to see the deadliness of grade crossings and demand that they be abolished regardless of expense. Where state and municipality have to pay their fair share, however, the questions are much more likely to be looked at from all angles. The New York Public Service Commission, Second District, states in its 1916 report, just issued, that there developed during the year a number of grade-crossing applications in which the cost of elimination was far out of proportion to the greater degree of safety to be attained. The commission deplores the fact that it is without power to order slight changes in the physical surroundings that would in many cases render such grade crossings reasonably safe. Again, the commission cites a typical case where it denied a petition because the elimination plan would have introduced greater dangers than those removed. This was because the plan called for a highway intersection just beyond, and obscured by, the underpass. The autoist might, therefore, pass under the train in safety only to collide with another vehicle on the cross road; it seems reasonable in such a case to leave the grade crossing and expect the autoist to heed the warning signs. The point is that when one's own pocketbook is affected one is much more likely to study the matter carefully and see whether the expenditure is warranted.

Sectionalizing a Society

THE Illinois Society of Engineers seeing clearly the vision of competitors arising about it, sapping with all the strength of youth the vigor of its own stanch growth of thirty-two years, has lost no time in providing amply under its own guiding hand for the various groups of its membership interested in surveying, roads and pavements, drainage, water supply and sewerage. The real awakening came last spring at a conference on drainage held at the University of Illinois and attended by nearly as many men as come to the state society meetings, though the leading spirits were practically all members of the society. After a helpful program had been finished the question of a permanent organization arose. The question whether to revise the nearly moribund Drainage and Levee District Association or to create in the engineers' society a definite, substantial place for the activities of this group of men—many of whom were lawyers, commissioners and operators—was quickly decided in favor of the latter proposal. The new plan, with its non-technical require-

ments and halved dues for section membership, should attract all those interested in the purpose of the different sections. It should solve that difficult problem, the arrangement of a program interesting to the greatest number. A surfeit of specialized papers, extremely interesting to a few, can now be disposed of with ease. Sections on unrelated subjects, such as drainage and structural engineering, can hold simultaneous meetings, and a two-day meeting will then give ample time for discussion. The working of the plan will be watched with keen interest by other state societies, which in late years have been groping to find themselves. The Illinois Society of Engineers may not have found the solution of the whole problem of the state society, but it is facing in the right direction and should receive hearty support.

A Time-Study of Conventions

SOME day some one will make a convincing protest against the American habit of carrying on our education in public. Perhaps there is no reason why this should be mentioned in particular connection with the recent convention of the American Wood Preservers' Association except that here is a large gathering of men who, like the men said to have surrounded a former president, should know exactly what they want. It is not quite clear why committees do not or cannot extract from the various points in their reports those of particular novelty, or those which they should know will arouse contention, and so state them that it is obvious just why the certain decision was reached. Surely men engaged in so specialized an industry as timber treatment should sense immediately these matters. Similarly, members who have had the printed reports for some days could digest their objections and so arrange them that their presentation would occupy seconds rather than minutes. As free-born American citizens we have the inalienable right to do as we please, apparently. But cannot we study our papers and reports for an hour or so, find the form in which the salient points may best be presented, to the end that, in the aggregate, many man-days will be saved?

Saving Money on Building Work

THE variable factors in concrete-building construction can be reduced so nearly to certainties that it is possible to predict the day and date of a result, such as the completion of a floor, to which many complicated operations contribute. So sure was the Abertshaw Construction Company of its advance schedule for the erection of the Colt's Arms Company's building in Hartford, Conn., that before work was started it published the date on which each floor would be completed. It then proceeded to carry out the schedule to a day, as told on page 186 of this issue. This is not the first building which this firm has constructed to schedule; in fact, all its work is handled in this way.

Neither is this the only firm which time-schedules all its work. The able planning and accurate office knowledge of field conditions which such feats imply are fast becoming prerequisite to any great measure of success in building construction. This company, however, is reputed to have gone farther than most along the path of construction efficiency, especially in the matter of handling the human elements of its organization. It saves money to employ the skill and foresight that makes possible such planning. It saves money to bring the human organization to such a pitch of efficiency that it can carry out these plans. Contractors in other lines can help themselves greatly by a study of methods that bring such results.

Education for Fire Prevention

AN OUTLET for the energies of the engineer who wishes to do his part in the improvement of civic conditions is afforded by the proposal of the National Fire Protection Association that instruction be given, especially in the schools, to impress on the public the facts regarding the waste, the cause and the prevention of fire. The association has prepared an excellent syllabus as a basis for instruction. The points are brought out emphatically by means of comparisons and by translating the figures into readily comprehended units. For example, the extent of the average annual fire loss in America, \$230,000,000, based upon the last 10-year period, is emphasized by the statement that it is equivalent to the loss of a \$4,000 home every 10 minutes, and that the year 1915 with twenty-six fires, involving individual losses ranging from \$500,000 to \$200,000,000, is a sample average year. The average annual per capita loss of 33 cents in Europe is compared with \$3 for the United States and Canada, not including the cost of maintaining fire departments. "Fire insurance does not replace lost property," and "Every fire is paid for by all the people" are two striking sentences used in pointing out the true economic significance of fire waste.

Worthy of strong indorsement by engineers are the proposals that the public authorities should certify to proper construction of chimneys and heating facilities, that the storage, handling and use of explosives should be regulated, that fire departments should make regular inspections to enforce the removal of rubbish and other fire-breeding dangers, that state building codes should regulate all building construction, that the use of untreated wood shingles in closely built-up communities should be forbidden and that ordinary windows should be replaced by metal frames and wire glass or by standard fire shutters in the commercial and business districts.

Many cities have made progress in the matter of building regulations looking to fire resistance. But the fact that our fire losses continue at enormous figures is eloquent testimony that there is still much to be done in the way of real fire prevention. More rapid progress can be obtained through the educational work proposed

by the National Fire Protection Association. Engineers can help by proffering their services to civic organizations which take up such educational work and by urging its initiation wherever they can make their influence felt.

Colonization After the War

AS a field for speculation, the readjustment of foreign industry to peace conditions has been fruitful. What will the nations do with their soldiers when the war is over? On the details of this great subject opinion is widely at variance, but there seems to be fairly general agreement on one main theme—that in the period of reconstruction the human elements of the industrial problem will reach new levels of importance. The signs all point that way. To engineers one of the most interesting of recent developments is the great Canadian colonization scheme which contemplates the use of land in the region of the Winnipeg Aqueduct by returning soldiers. Already the officials of the Greater Winnipeg Water District, in co-operation with the dominion and provincial governments, are at work upon the project. Some of its details were set forth this month in an article by A. A. Stoughton of the University of Manitoba, appearing in the *Manitoba Free Press*. The dominion government is to give the land, the provincial government is to make the physical improvements, such as roads and drainage, while the Water District is to construct the community center, together with school houses, playgrounds, public meeting halls, etc.

The success of such a settlement, as Mr. Stoughton points out, depends upon the thorough planning of all its features, physical and social as well as agricultural and economic. Here is a field in which the engineer has big opportunities to use his specialized knowledge. Another settlement plan is to be put in operation at once by the Canadian Pacific Railroad for men who have served with Canadian units in the British forces. Improvements in the form of houses, barns, water supply and other accessories are to be made by the company. The colonists will be tenants for three years, not making any payment of rent during that period. After three years, however, an amount equal to 6 per cent on the cost of permanent improvements will be charged for each year that has passed since the colonists went into occupation. Under an alternative plan land will be sold to settlers on a 20-year basis, the first payment not being due till the end of the second year.

Engineers and others familiar with the various reclamation projects in this country, with the activities of the land speculators and with the collapse of many little homestead projects due to unsound financial policies which were permitted to exist by the powers in charge, will follow with interest the working out of the Canadian colonization scheme.

While these projects are primarily in the field of agriculture, it is not unreasonable to expect in the regeneration of the industrial activities of the nations

now at war similar provisions regarding the human features. We may reasonably look for a great deal more of the so-called welfare work in industry—work which will involve not merely better housing, but opportunities for recreation and education. In some large American manufacturing plants to-day marked progress along these lines has been made. Under the stimulus of European example after the war, this work will assume in the United States a broad scope, and if the engineer will take his part in it, he is certain to attain a new prominence.

Shall Convicts Be Used on the Roads?

THE OBJECTIONS urged against convict labor are many and varied. They range from arguments based on economics to those which apparently seem to have the most humanitarian foundations. Whatever solution of the problem may be found, it will inevitably be pragmatic and its criterion will be, "Does it work?" That it has worked cannot be denied, for in certain sections the prison authorities have not only succeeded in constructing excellent roads at a cost far below that possible with free labor, but have attained the much-needed end of making the convict realize that road work is honorable labor and a mark of his potential fitness to live again with society. When it has been possible to dispense with chains and the too obvious presence or armed guards, the much-feared debasing effect upon the public disappears.

But of course the essential human quality of the problem will prevent its perfection to any greater degree than, say, our educational system. The fact that our schools, though they inculcate discipline and spend years upon the three R's, neither assure honest nor accurate clerks and engineers is no reason for dismissing the teachers and closing the classrooms. One success justifies a hundred failures, for to such small percentages is all progress due. Nor should the hardships of working during the winter months force northern sections to decide against the convict building of roads, for there are many germane tasks better carried on under cover—for instance, the fabrication of concrete culverts, bridge-floor slabs and the like.

Such matters as the last mentioned are of the type which study will solve and which now constitute the basis of the opposition to a widespread employment of convicts on those public works where they interfere least with free labor. It must be admitted that it will not do to let prisoners "rot in their cells," and this is, in itself, a sufficient answer to the statement that such labor is inefficient. But there is not a single reason why road building should present a more difficult problem of organization than, say, the manufacture of shoes, and the greater chance of escape must balance to only a small degree the greater healthfulness of outdoor work and the opportunity of returning to society—not a health-broken, degenerate wreck, but a unit whose physical well-being is excellent and whose moral attitude has had every opportunity of improving.

Old Macadam Resurfaced with Sheet Asphalt in New Haven

Success of This Type of Pavement Demands Careful Preparation of the Foundation

By W. L. HARLOW

Asphalt Inspector, Bureau of Engineering, New Haven



THE SAME STREET BEFORE AND AFTER LAYING SHEET ASPHALT ON OLD MACADAM SURFACE

DURING the season of 1916 the city of New Haven, Conn., contracted to have 98,868 sq. yd. of old pavement resurfaced with sheet asphalt. This old pavement, covering twenty-two streets, consisted of about 92,000 sq. yd. of old waterbound macadam surface and of about 7000 sq. yd. of old brick, concrete or Belgian block surface. The work was started in May and completed in December, and all kinds of troubles were encountered, from railroad embargoes on paving material to labor strikes on the work. In spite of these difficulties the contractor managed to lay an average of 760 sq. yd. of finished 3-in. pavement per working day on old macadam surface and an average of 1220 sq. yd. of finished 2-in. pavement on old brick or block surface.

The traffic yardage on the resurfaced streets was as follows: Heavy traffic, 21,480 sq. yd.; moderate traffic, 52,090 sq. yd.; light traffic, 25,298 sq. yd.

MACADAM STREETS BADLY WORN

The picture accompanying this article, showing the condition of one of the streets before being improved, is fairly typical and offers a marked contrast to the views of the same street from the same location after improvement. All the old waterbound surfaces had either straight macadam or Telford macadam foundations, with brick or cobble gutters and flag and cobble crosswalks. The grades were mostly light and in no case exceeded 4 per cent. The streets were badly worn in the center, in some cases being 2 or 3 in. below the manhole covers. This condition caused an abrupt change of crown at the shoulders, which in most cases had to be taken down or graded up from the gutters. The policy throughout, however, was to leave the old macadam undisturbed as much as possible, and the new grades were fitted to the streets with this in mind. No

attempt was made to adhere to any fixed rule for grade and crown.

The specifications for this work were drawn from the standards of the American Society of Municipal Improvements for sheet asphalt pavements, modified, of course, to meet the existing conditions and with a few additional clauses necessary for resurfacing work. Except where the resurfacing was done on old brick or Belgian-block surfaces, the contract called for 3 in. of pavement, consisting of 1½ in. of binder course and 1½ in. of wearing surface. On old brick or Belgian-block streets 2 in. of wearing surface was used with no binder course.

EXTRA BINDER

All binder that was used in a street in excess of the estimated quantity required to cover the street with a 1½-in. course was known as extra binder and was paid for extra by the short ton. However, the price of this binder was not allowed by the contract to exceed 15 cents per square yard, and when this occurred it was a loss to the contractor.

This practice was found to be more or less unsatisfactory, owing to the fact that the weight of 1 sq. yd. of binder 1½ in. thick was a variable, and on this account it was impossible to compute with certainty the quantity of extra binder. This consequently worked as an injustice to the contractor in one case and a loss to the city in the other. It is therefore recommended, in order to eliminate this unfairness to both parties, that all binder be bought by the short ton in place on the street, and that the present practice of buying the wearing surface by the square yard be continued. The pavements were guaranteed for 5 years by the contractor.

The mineral aggregate of the binder course consisted of 75 to 80 per cent by weight of crusher-run broken traprock, all passing a $\frac{3}{4}$ -in. screen and retained on a $\frac{1}{4}$ -in. screen, and 20 to 25 per cent of sand for a filler. This was incorporated with 4.5 to 5.5 per cent by weight of refined Mexican asphaltic cement, and a fairly close binder resulted. The wearing surface contained from 10.5 to 11.5 per cent of refined Mexican asphalt, and the mineral aggregate was for the most part bank-run sand, of which the following screening is representative:

GRADING OF SAND USED IN ASPHALT MIXTURE

	Per Cent		Per Cent
Passing No. 200 screen.....	5.0	Passing No. 30 screen.....	13.0
Passing No. 100 screen.....	16.0	Passing No. 20 screen.....	8.0
Passing No. 80 screen.....	5.0	Passing No. 10 screen.....	4.0
Passing No. 50 screen.....	25.0	Retained on No. 8 screen...	0.0
Passing No. 40 screen.....	24.0		

The grains in this sand were chiefly quartz, rough-surfaced, and had considerable clayey material adhering to them, which required somewhat more than the normal amount of bitumen to coat them thoroughly. On light traffic streets a coarser sand was mixed with this aggregate, which brought the larger screenings up somewhat. Limestone dust was used as a filler and was added in such quantities as was necessary to bring the total mineral aggregate passing the No. 200 screen up to 10 per cent. On the heavy-traffic streets this was increased to 13 per cent. All the asphaltic cement was 99.9 per cent bitumen soluble in carbon disulphide and carbon tetrachloride. The penetration of the asphaltic cement varied from 50 to 60, the harder material going on the heavy-traffic streets and the softer material on the light-traffic streets, 55 penetration being used on moderate-traffic streets.

MOTOR TRUCKS HAUL ASPHALT

A No. 2 one-car Merriman asphalt plant was used on this work. The plant was set up on a spur track which was centrally located to handle all the work done. In no case did the round-trip haul exceed 4 miles, and



AVERAGE TRAFFIC CONDITIONS ON ONE OF NEW HAVEN'S RESURFACED STREETS

averaged about 2 miles. Sand and broken stone were received in part by rail at the plant and the rest was hauled by truck at night. All asphaltic cement was received in tank cars by rail except when railroad embargoes held up the delivery of the material; then, to keep the plant in operation, the kettles were charged from a supply of asphaltic cement in metal drums kept

on hand for such emergencies. Five-ton Pierce-Arrow motor trucks were used to haul practically all the hot stuff to the streets, and besides doing service during the daytime were used considerably at night to haul sand and other materials.

The streets were prepared for resurfacing entirely by the city's forces, the contractor, however, being required by contract to broom the streets thoroughly before applying the binder course. As soon as the en-



THE LIFE OF THESE RESURFACED STREETS IS ESTIMATED AT FROM 5 TO 15 YEARS

gineers had established grades on a street, the city's employees were set to work removing all loose material, tearing out cross-walks and other places that were high. The material thus obtained was used to regrade these places, any surplus being used to fill other low spots. All bad curbing was renewed or reset and all manhole covers brought to the proposed grade. The streets were scarified as little as possible, as it was believed that the old material, if left undisturbed, was far superior to any that could replace it. All places that had been fixed were wetted and thoroughly compacted with a 15-ton three-wheel Buffalo-Pitts roller. Where it was possible, the streets after being repaired were opened to traffic further to consolidate the macadam surface.

The hotstuff, as soon as it was mixed at the plant, was quickly conveyed to the streets in motor trucks. In cold and inclement weather all loads of binder and wearing surface were covered with canvas. On the street all the usual precautions were taken in the depositing, raking, and rolling the material. As a general practice, no larger area of binder course was laid than could be covered with one day's run of the plant on wearing surface. The asphalt surface was kept about $\frac{1}{4}$ in. high around all manhole covers and boxes, as well as along car tracks where they existed, and where no liners were used. Smoothing irons were used only where absolutely necessary, as it was believed to be better practice to let the traffic iron out the small irregularities that may appear in the finished surface.

REPORT FORM USED

The laying of the asphalt was supervised by two inspectors, one stationed at the asphalt plant and one on the street. Daily control of the sand was kept at the plant by screen analyses and penetration tests were made on all asphaltic cement used. Pat tests were made often and scale weights and temperatures were

Second-Largest Concrete Building Erected

Two Units of Hoboken Water Terminal Containing 660,000 Square Feet of Floor Built Between June 6 and October 31 with One Set of Forms

WORKING SINGLE shift, without Sunday or holiday labor, and using but two mixers and a single set of forms above the first floor, the Turner Construction Company completed, between June 6 and Oct. 31 last, two units of a reinforced-concrete structure on the Hoboken waterfront of New York harbor containing 660,000 sq. ft. of slab, exclusive of the basement floor. A special set of panel forms was used for the basement walls and first-floor slab, which is of the mushroom type, but for all floors above the first, these being of beam and girder construction, a single set of forms sufficed. For a good portion of the time after the work was well under way progress averaged a floor a week. One entire floor containing 55,000 sq. ft. of slab was completed in 4½ days. Concreting progressed from the twin towers outward, the forms being removed below and re-erected above a few bays at a time. The buildings are almost entirely of concrete, no brick or flooring and very little tile being required. On this account, and because of the location at a rail-water terminal, the problem of delivering and handling materials was simplified.

BUILDING ONE OF LARGEST IN COUNTRY

The building is located above Fourteenth Street and in line with Washington Street in Hoboken, N. J., on the south side of a slip leading to the Hudson River just north of the Fourteenth Street (Hoboken) ferry house. When completed it will be in the shape of a U, with the long axis parallel to the slip. The building

will be divided by concrete fire walls into four independent sections, each rented to a different tenant. Two of these sections, comprising half of the base and all of that leg of the U next the slip, compose the structure which was completed within the time mentioned. The first portion of the building to be constructed adjoins the east end of the part just completed and forms the south part of the base of the U and the east part of its southern leg. This structure, built by the same contractor, was completed between June 4 and Sept. 15, 1915.

The portion of the structure at present completed, comprising these three units, is said to form the second largest reinforced-concrete building yet erected, being exceeded only by one of the Bush Terminal buildings in Brooklyn, N. Y.

UNUSUAL STORY HEIGHT ADOPTED

The three units, taken together on the basis of cubic contents, perhaps form one of the largest buildings in the country because of the unusual story height of 14 ft. 6 in. This story height was selected because the owners were desirous of having an exceptionally well-lighted structure. Moreover, the building will be occupied by manufacturing concerns using a great deal of overhead shafting for the transmission of power. Provision for securing the hangers for this shafting to the floorbeams was made during the construction of the building by placing short lengths of ¾-in. pipe across the beam boxes at the proper intervals and con-



SECOND-LARGEST CONCRETE BUILDING APPEARS FROM HUDSON RIVER AS HUGE WHITE BLOCK AGAINST SKY

creting them in. These pipes were inserted at such a height as to bring them about 2 in. below the finished ceiling. A bolt is passed through each pipe which clamps a pair of hangers, one on each side of the beam.

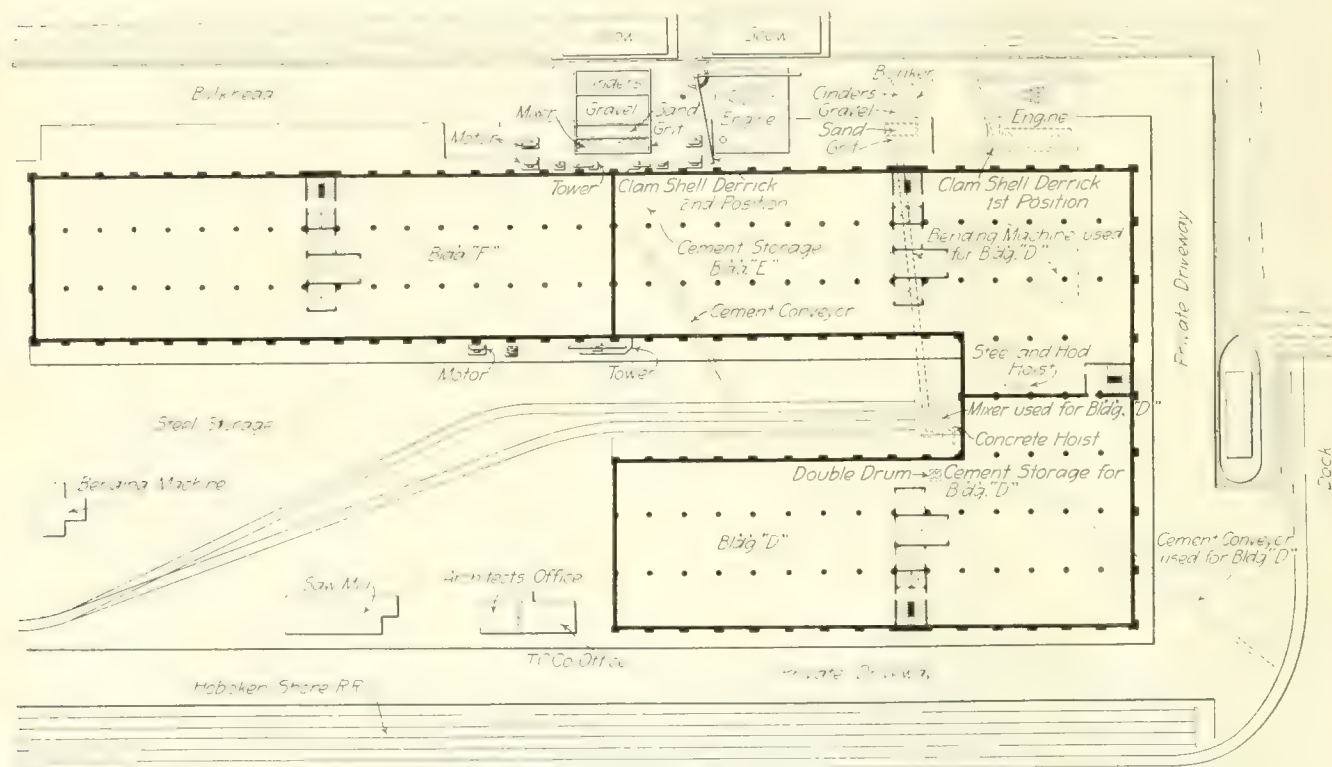
The exterior walls, all the stairways and the skylight framing are of reinforced concrete. The stair wells are surrounded by partitions of hollow tile. The fire walls between sections of the building, however, are of concrete. The windows are of steel sash, glazed with wire glass.

ONE DERRICK FOR TWO CONCRETE PLANTS

The building is founded on wood piles averaging 40 ft. in length. Those for the section erected in 1915, known as building D, were driven during the spring of that year. Those for sections E and F, erected last

seen from the layout drawing, the towers were directly south of the new bins in this location. The tracks for the swivel dump cars which supplied the mixers were thus very short and the cars could be operated by hand. By securing a thoroughly competent hoisting engineer, the one derrick with a $1\frac{1}{2}$ -yd. bucket was able to supply the bins with sufficient material to keep both mixers in operation, though each plant alone frequently poured 400 yd. a day. The operation of the concrete mixers was organized so that there was always one batch in the mixer while a skip of concrete was being hoisted in the tower, one dry batch in the charging hopper of the mixer and one dry batch being drawn into the small car from gates under the material bins.

Piles, reinforcing steel and cement were delivered to the work by rail on sidings located inside the area



DOUBLE CONCRETE PLANT, SERVED BY ONE DERRICK, POURED 800 YARDS A DAY

summer, were driven at the convenience of the contractor, after the completion of building D and before the beginning of warm weather last spring. Most of this work was done with land drivers, only a few rows of piles next the slip, which support the new dock, requiring the use of a floating machine.

In constructing section D a single concrete mixer and tower located on the north side of the building had been used. This plant was supplied with aggregate by a pair of cars running on a double narrow-gage track to hoppers set on the south side of the slip. The cars were operated by a hoisting engine and the bins filled with material from barges by a derrick and grab bucket. During the winter this plant was moved west to a location on the slip and another mixer and hoisting tower were added to it. In its new position the enlarged plant was symmetrical about the center line of the fire wall separating the units E and F of the building. One $1\frac{1}{2}$ -yd. Smith mixer and one hoisting tower were thus provided for each section. As will be

bounded by the U. A line of gravity rollers was installed from the nearest of these sidings through the building alongside the fire wall above the first-floor level to a point opposite the mixers at the level of the charging platforms. Cement was unloaded from box cars in this way and conveyed to the mixers. In addition, a storage capacity of several cars was provided in building E at the first-floor level.

The reinforcing steel was bent and stored on the south side of the buildings. An additional tower was located near the center of the south side of the section. On the corners of this were mounted two booms used to hoist the reinforcing to the desired floor. The tower also contained a cage large enough to hold two buggies. This cage was used to hoist the tile. The men, however, used the stairways throughout the job in spite of the unusual height, a total climb of more than 190 ft. from the ground being necessary to reach the roof.

Work on the concrete forms began with a full force



IMMENSE STRUCTURE CARRIED UP WITH ONE SET OF FORMS

of carpenters about a month before time for concreting. All the forms were of wood except the Blaw forms for the round interior columns. The flat-slab forms for the first-floor and basement walls were completed first, and while these were being poured the single set of forms provided for all floors above the first was finished. A circular motor-driven saw was used in this work.

It was unnecessary to provide more than one set of forms in order to keep the mixers running continuously on account of the large floor area involved. Before the last of one floor had been finished, it would be safe to remove forms from the first portion poured. The forms were raised and re-erected in irregular-shaped units, which, however, were the same shape and location throughout, and which averaged about nine bays in area. Each floor was begun by pouring the unit adjoining the hoisting tower, beginning at the further edges of the unit and taking up the runways for the concrete buggies toward the tower as the work progressed. Next day, when the adjoining section of form was ready, these runways would be replaced on top of the finished section. Work progressed in this way until the far corner of the floor, diagonally opposite the tower, was reached. About 14 wheelers were required in starting a floor. To maintain the same rate of progress as the work reached the far edges of the floor it was necessary to increase the number until 18 buggies were in service.

STAIRS CONCRETED SEPARATELY

As the work progressed it was necessary to piece out the form panels on account of the decreasing size of columns and beams. Section E has been leased for a long term to a tenant who will have very light loads on the seventh, eighth and ninth floors. The form panels for this building between the floorbeams had to be con-

siderably enlarged on reaching these floors, and had to be cut down again for the tenth floor.

Practically the only formwork left behind as the main floors were carried up was that for the stairs, of which there are two sets in each section. These were formed and poured one or two floors below the main work. As the concrete towers were carried up, a hopper was left at each floor level into which concrete could be dumped at will by setting the trip at that floor. It was thus possible to deliver concrete at any level for finishing stairs or other small jobs.

Tile partitions around one stair well and around the freight and passenger elevator shafts subdivide each unit into separate halves to reduce the fire hazard. Except for these, all of the floors are open full length and width. On this account, the trim furnished under the general contract was a small quantity compared to the size of the building. All machinery, except that for the heating and lighting plant of the building, is installed by the tenants. The piping and conduits for the steam heat and lighting wires were carried up by the contractor as the forms were stripped from each floor. The pipe was raised to the proper floors by hand with light tackle.

The daily force employed on the building included 78 carpenters, 325 laborers and 14 to 16 lathers, who placed the reinforcing steel in the forms. The building has been constructed for the Hoboken Land & Improvement Company under the direction of Charles Fall, architect, by the Turner Construction Company. The construction has been in charge of Albert Larsen as superintendent.

Machine-Mixed Filler Best for Granite-Block Pavement Joints

Greater Economy and More Perfect Results May Be Obtained Mechanically Than by Time-Honored Manual Methods

SCARCITY of labor during the last year and a half has forced engineers and contractors to resort more generally to mechanical methods of filling joints in granite-block pavement instead of the old practice of hand pouring. Recent tendencies also point to the elimination of gravel and pea stone in the joints and the use of asphalt or tar-sand mastic and straight 1:1 cement-sand grout. These are some of the changes in practice which have been observed by Zenas W. Carter, field secretary of the Granite Block Manufacturers' As-



A POWER-DRIVEN MASTIC MIXER GIVES BEST RESULTS



SPECIAL MIXER FOR GROUT GETS RESULTS AND SAVES LABOR

sociation, from whom this journal has received the information upon which the following notes are based:

MECHANICAL METHODS GAINING PREFERENCE

The mechanical mixing of concrete for street foundation is now a feature of many modern specifications, and tendencies indicate that the better quality of concrete so produced will find a reflection in a demand for machine-mixed grout and bituminous fillers as soon as a machine for this purpose has been developed to a point where it will be dependable and economical. Experience shows that the conventional drum mixer can be used without trouble and with many advantages in preparing and depositing cement-sand grout. Not only is there a labor saving in men, but the fatiguing work of the box and hoe method is eliminated.

With bituminous fillers the advantages should prove to be even greater. The heavy, resisting nature of even heated asphalt and tars is increased by the addition of sand, the result being quickly tiring muscles and a disposition on the part of the men to diminish the sand percentage and to slight the mixing. It is hardly necessary to mention the effect of an inadequate distribution of sand through the bitumen, but it is not so generally recognized that too rich a mastic cannot give the necessary support to the edges of the block and will, furthermore, produce a sticky, impassable pavement.

The introduction of modern methods is being aided by the growing demand for more perfectly cut granite

blocks. The newer specifications are responsible for so perfect a cutting that the brooming of gravel and pea stone into the joints is impossible. The older practice made this step necessary, since the interblock spaces were so large that a mastic which could be placed would not remain placed unless more or less supported by a larger aggregate.

At first the method of adding the heated sand to the hot bitumen was very crude. The bitumen was drawn into the hand-pouring kettle, a shovelful or more of heated sand was dumped into the kettle and the pourer then stirred it together before pouring it into the joints. In some of the work in Brooklyn and in Cleveland the mastic filler was mixed in special heated tanks, into which the heated bitumen and heated sand were poured separately and then thoroughly mixed by means of a screw or fan blade on a shaft rotated by a handcrank outside the tank. The filler was then drawn off and poured from standard pouring kettles.

Recently, however, in Brooklyn, there has come into use a truly mechanical mixing of this asphalt or tar-sand mastic filler. The illustration shows a fan-bladed shaft-tank mixer into which the heated asphalt and



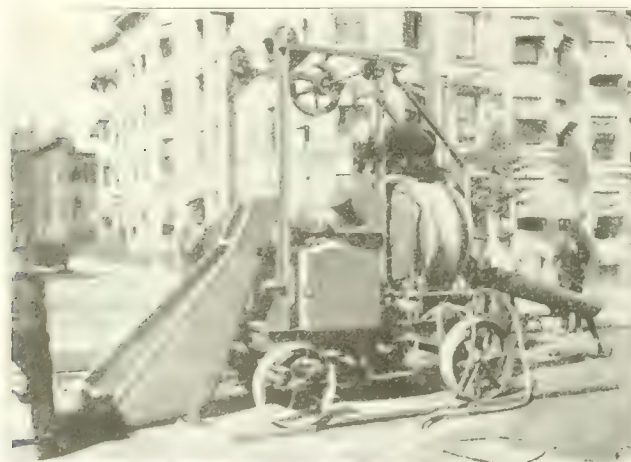
MASTIC SPREADS EASILY AND GIVES BITUMINOUS MAT

heated sand are dumped and the mastic thus made is drawn off into huge carrying tubs or heated steel wheelbarrows. Dumping instead of pouring gives the best results in mild or warm weather, when the blocks are thoroughly dry and warm.

Contractors using these simpler and quicker methods of handling the mixing and distribution of the mastic and grout fillers report savings in labor amounting to from 25 to 40 per cent.

Cement Production for 1916

According to figures furnished by the Portland Cement Association the cement production for 1916 was 91,333,000 bbl., while shipments were 94,522,000 bbl. These figures are based on actual returns from 105 plants and on estimates for some other plants which do not report. Compared with these figures are those recently sent out by the United States Geological Survey, which give a production of 91,194,000 bbl. and shipments of 94,508,000 bbl. Although the production during 1916 is slightly below the previous high record of 1913, the shipments reported for the past year hold the record.



USE YOUR CONCRETE MIXER FOR GROUT



STAIRWAY COVERING AT ENTRANCE, SOUTH STATION UNDER

Polished Concrete in Surface Structures of Boston Subways

Stairway and Escalator Coverings Have Special Architectural Features—Granite Concrete Mixture Described and Costs Given

By LAURENCE M. MANLEY

Assistant Engineer, Boston Transit Commission, Boston

OVER the stairways and escalators of the newest Boston tunnel stations, shelters of masonry with polished granite walls and ornamental concrete roofs have been constructed which combine in a harmonious manner the advantages of both materials. These structures have been built by the Boston Transit Commission in connection with the finish of the stations of the East Boston tunnel extension in Scollay and Bowdoin Squares and of the Dorchester tunnel in Dewey Square. The latter, called "South Station Under," was described by W. W. Lewis in the Engineering Record of Dec. 30, 1916, page 800. They are of two types, a low, half-covered shelter over the fixed stairs and a higher and more ornamental structure which completely covers the machinery and upper landing of the moving stairs.

STAIRWAY COVERINGS

The coverings over the stairways consist of a parapet wall 3 ft. 3 in. high, of polished dark Quincy granite, set on a low coping of concrete and roofed over for about half of its length with a slightly arched slab of reinforced concrete, the dark surface of which is rubbed smooth to reveal the granite aggregate. At its forward end the top of the roof is raised to form the support of the copper-covered frame of the destination sign, made of wood, which is illuminated from above by ten incandescent lights placed under its overhanging roof.

The parapet wall extends 18 in. beyond the top riser of the stairs to allow for handrail connections, and terminates in a granite post 11 x 13 in. in section, set about 2 ft. into the concrete for the lateral support of the unroofed portion of the walls. The slabs are 7 in. thick and are given a high polish on all exposed surfaces. The whole structure is 15 ft. 2 in. long and 4 ft. 6 in. high at the crown of the arched portion of the roof.

The stairs are of precast reinforced-concrete units with 7 in. risers and 11 in. treads, and are provided with grooves along the back and across the ends of each tread to lead rain water to the sumps at the landings. The granolithic coping, finished like the stairs, rises 6 in. above the sidewalk and shows on the inside for a depth of 15 in. Below the coping, as far as the second landing, the walls are finished with granite terrazzo, which is easily kept clean and is little affected by driving rain or frost. For stairways of the usual width of 8 ft. two side rails and one center handrail are provided.

ESCALATOR HEADHOUSE

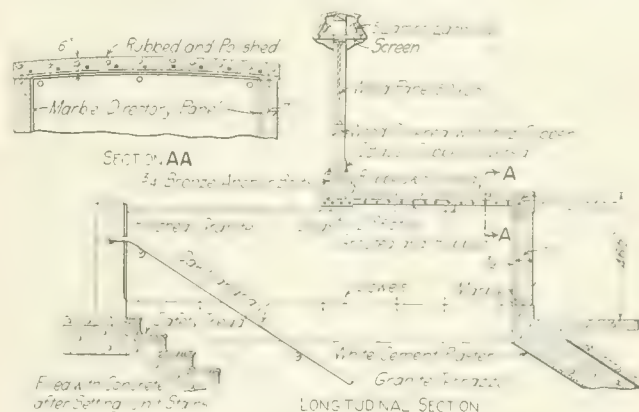
The buildings over the escalators are also constructed of polished granite and concrete and are like those over the fixed stairs, but are enlarged and extended to shelter the moving stairs. The rear portion of these buildings is of the same height and shape as those over the stairways, but in place of the open well hole the upper part of the escalators is covered by a sloping roof and the landing at the street level is housed in by a headhouse 10 ft. high, which extends 4 ft. in advance of the handrails. The granite walls of this headhouse are 10 in. thick and extend to the elevation of the top of the sloping roof, 6 ft. 1 in. above the landing. Above this level the walls are of concrete, the surface of which is broken up into moldings, sunken panels and an elaborate cornice around the eaves of the arched roof.

Over the entrance an elliptical arch springs from the top of the granite walls and the opening below is closed in by a glazed transom and swinging copper-covered doors. At the Scollay Square escalator the full opening is available through four doors, but on later constructions at Dewey Square a fixed center panel is provided, behind which a heated shelter for the attendant may be placed.

DETAILS OF ESCALATOR COVERINGS

The general appearance and details of the escalator coverings are shown by a drawing and a photograph. The building shown in the drawing is, on account of the spacing of the escalators, 2 ft. 6 in. wider than that shown by the photograph, and has four swinging doors in place of two on the narrower building. Otherwise the escalators are identical in design.

The escalators were constructed by the Otis Elevator Company and are of the cleat type, each file 2 ft. wide between the handrails. In the wider building there are two single-file escalators which are spaced 42 in. apart



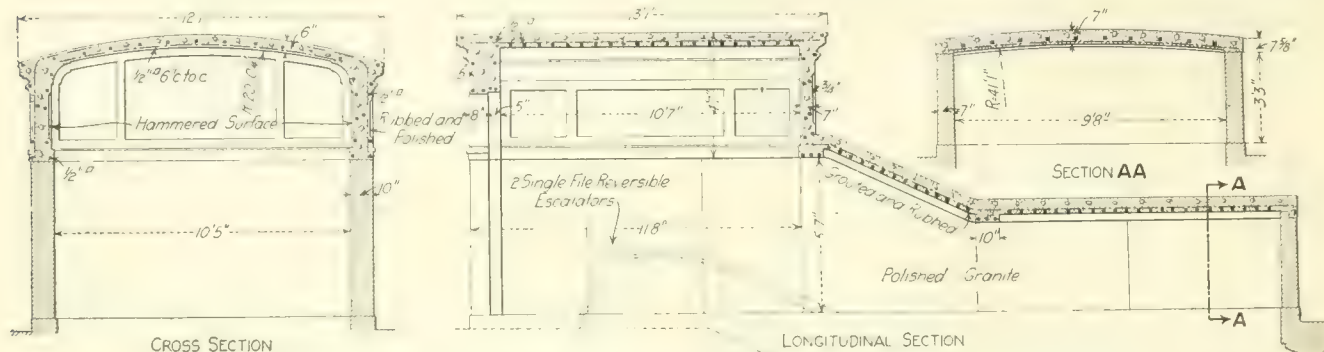
DETAILS OF STAIRWAY COVERING, SHOWING MATERIALS USED

between handrails to prevent interference between passengers when the files are moving in opposite directions. In the narrower buildings, where both files move upward, the spacing is 9 in. The escalator from the lower platform of the South Station Under to Dewey Square at Federal Street has a vertical lift of 43 ft. 9 in. and a total length of 103.5 ft.

For practical reasons the roofs of the structures under discussion are constructed of concrete, and much care has been exercised to produce surfaces which would form an agreeable contrast to the polished granite upon which they rest. The main body of the concrete is of

latter forms have been used three times and are stored for further use.

The inside forms were constructed of plaster about $\frac{3}{4}$ in. thick applied on wire netting fastened over rough wooden lagging. Portland-cement plaster was used for forms on the first buildings constructed, and on some of the later work plaster of paris mixed with a small quantity of lime was substituted. On account of the rapidity of its set, the plaster-of-paris forms were made more quickly than those of Portland cement, but the resulting concrete did not seem to justify the use of this material. The plaster seemed to soften and break



DETAILS OF HEADHOUSE FOR ESCALATORS—POLISHED GRANITE WALLS AND CONCRETE ROOF

the ordinary 1:2:4 mixture, with a veneer of granite mixture cast at the same operation on the exposed faces. The exterior surfaces are rubbed and polished and a portion of the interior surfaces are patent hammered.

The concrete was mixed and placed by the commission's force of skilled laborers assisted by a terrazzo worker. A layer of granite mixture 1 in. thick was first spread on the forms and carefully compacted. The steel reinforcement was then set and the interior concrete, mixed as wet as possible, was placed, the granite being carried up on the edges. Vertical walls were cast solid of the granite mixture, which was carefully placed with trowels, no spading against the forms being permitted. All the operations were carried on so as to keep the maximum amount of aggregate at the surface. On the top of the roofs a 1-in. layer of granite mixture was spread and screeded, dry cement was added to stiffen the mixture and additional granite spread over the surface and rolled and troweled into place.

PROPORTIONS OF GRANITE MIXTURE

The proportions of the granite mixture were as follows: Cement, dark Hudson River Atlas and Alpha, 4 bags; crushed dark Quincy granite, $\frac{1}{8}$ to $\frac{3}{8}$ in., 8 bags; lampblack, Germantown, screened with the cement, $\frac{1}{2}$ to 1 lb. The smaller amount of lampblack gave the best results on the hammered work and the larger amount the best on the rubbed work. The most satisfactory granite aggregate was obtained from the same quarry from which the parapet slabs were taken. It was crushed with considerable difficulty in a small terrazzo crusher at a cost of about \$17 per ton. The crushed granite contained about 42 per cent voids.

The outside forms were made of cypress in a wood-working mill. The cost, including spruce ribs for the support of roof forms, was \$24 for stairway coverings and \$160 for those over the escalators. One set of the

up while the concrete was being placed, and notwithstanding its two coats of shellac, considerable trouble was experienced in removing it from the finished concrete.

The use of plaster forms was suggested by the satisfactory results obtained from forms of the same material for casting thin, segmental slabs of white cement 5 ft. long by 2.5 ft. wide which were set between roof beams at one of the tunnel stations to hide an unsightly space above. Both wood and metal-covered forms failed to produce the smooth, unmarked concrete surface required, and the wooden forms were finally covered with a layer of Portland-cement plaster $\frac{3}{4}$ in. thick, troweled smooth. The plaster forms were coated with Min-wax clear waterproofing and soap powder, and the white cement slabs cast upon them were removed without difficulty after a set of two days. These slabs were put in place without any further treatment and at a short distance cannot be distinguished from the white plaster adjoining.

USE OF PLASTER FORMS SATISFACTORY

The results from the use of plaster forms on the work under discussion were very satisfactory, except that in some cases difficulty was experienced in removing the plaster from the concrete. It is probable that the trouble was caused by the ramming of the concrete while it was being placed, which caused the particles of stone to cut into the plaster forms with a resulting bond between the two. The greatest difficulty was experienced with the soft plaster-of-paris forms, while the hard and well-seasoned forms of cement were removed with little trouble. The resulting concrete surfaces were practically as smooth as plaster without the danger of peeling inherent in plaster in such exposed locations. The gain over wood forms in smoothness of surface, watertightness and freedom from

warping was made, however, at a considerable added expense on account of the high price of plasterers' labor.

The outside surface of all the concrete has been rubbed and polished, the inside surface grouted and rubbed except at the upper walls and roof of the escalator headhouses, which are patent-hammered. The hammered work was six cut on the panels and eight cut on the pilasters and moldings, and in appearance closely resembled cut granite.

The rubbed surfaces were also hammered roughly as a preliminary treatment and the arrises were made straight and sharp by chiseling. On the first coverings constructed, this hammering was omitted and it was found that, during the laborious work of rubbing about $\frac{1}{8}$ in. from the surface of the concrete, straight lines became wavy, curves became uneven, and hollows appeared in plane surfaces in spots convenient to rub. The preliminary hammering and chiseling rectified

stone and polishing putty. This treatment gave a high polish to the granite aggregate showing on about 60 per cent of the surface and smoothed the cement to as near a polish as it would take. The "close up" photograph shows the appearance of some of the best of the finished surface.

This surface is obviously that of an artificial product, not to be compared with the granite cast in Nature's mold. It is, notwithstanding, dense, weather-resisting and clean and affords a contrast to the rest of the structure which is not unpleasing.

A table of costs is given herewith. The polished granite and the doors and signs were furnished and erected by contract, the mixing and placing of the concrete were done by the commission's day-labor force and the remainder of the work was done by skilled me-

COST OF COVERINGS OVER STAIRWAYS AND ESCALATORS IN DEWEY SQUARE, CONSTRUCTED IN 1916

	Buildings over escalators, average of two	Buildings over stairways, average of four
Wooden forms (used 3 times)	\$65.00	approx. \$10.00
Erecting forms	190.00	31.45
Plastering forms	180.56	15.35
Stripping forms	36.93	17.15
Concrete, labor	146.50	52.00
Concrete, materials	163.72	25.71
Hammering	254.91	32.52
Rubbing	251.98	68.59
Polished granite	1,120.00	490.00
Copper-covered doors	233.00	
Copper-covered signs		105.00
Total	\$2 642.60	\$847.77
Engineering and overhead expense not included.		

many minor irregularities in the lines of the structure and, by reducing the amount of rubbing, preserved these lines and lessened the cost of this portion of the finish.

The first rubbing was made with a coarse carborundum brick (No. 60) fastened to a wooden handle about 3 ft. long, and was continued until the marks of the hammer were removed and the granite aggregate was revealed. The removal of the outside skin of cement by hammering and rubbing exposed the imperfections in the structure of the concrete, and numerous small voids caused by excess water, entrained air, and by bits of granite pulled out of the concrete by rubbing

were disclosed. After this rubbing, the concrete was thoroughly cleaned, first with diluted acid and finally with a stream of water from a hose, and the surface was grouted with neat cement darkened with lampblack and well rubbed in. The grout was allowed to set under damp cloths for one day, and in the open with frequent sprinklings for about one week.

The surface was then given successive rubbings with three finer grades of carborundum bricks and was finally polished with a hone



COVERING FOR DOUBLE-FILE ESCALATOR, SOUTH STATION UNDER

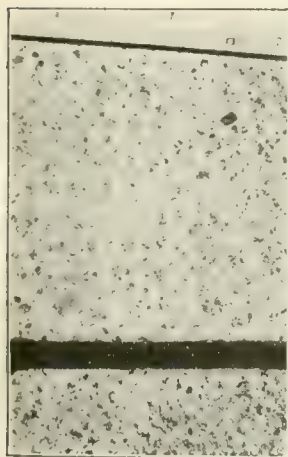
chanics at cost plus 10 per cent and insurance from contractors doing work on other portions of the station.

The cost of the preliminary hammering of the outside of the escalator coverings, including the chiseling of the arrises (790 ft. in length), was $42\frac{1}{2}$ cents per square foot of developed surface. Deducting 12 cents per linear foot for chiseling arrises, the net cost of the hammering was 13 cents per square foot. The cost of hammering the inside surfaces, mostly ceilings, with six and eight-cut work was 46 cents per square foot, or after making the same deduction for chiseling corners, 27 cents per square foot.

The rates paid for labor were as follows:

	Cents per hour
Carpenters	40 and 50
Stonecutters	65 and 70
Terrazzo mechanics	53 1/2
Terrazzo rubbers	33 1/2
Plasterers	70
Plasterers' helpers	45
Laborers	28 1/2 and 31 1/2

The scheme of the stairway and escalator coverings described in the foregoing was adapted in the office of the Boston Transit Commission, of which Edmund S. Davis is chief engineer, from designs furnished by A. A. Shurtleff, landscape architect, in consultation with George Lawrence Smith, architect. The construction as a part of the finish of the tunnel stations was under the supervision of the writer.



POLISHED CONCRETE ABOVE
—POLISHED GRANITE BELOW



EVEN IN ROCK THE WATER MUST BE TAKEN CARE OF BY DITCHING

Heavy Trucks and High-Material Prices Affect Massachusetts Road Work in 1916

With Wages High and Labor Scarce the Highway Commission Was Unable to Complete Contemplated Program, According to Annual Report

IN the face of the unusual conditions obtaining during 1916, the annual report of the Massachusetts Highway Commission, from an advance copy of which the following notes have been taken, shows that existing roads have been maintained in fair condition, new construction completed over a satisfactory mileage, and a general advance gained in the knowledge and use of the newer road materials. The report suggests certain additional legislation, chiefly that new and equitable sources of revenue from motor traffic and benefited communities be uncovered and made available for maintenance and reconstruction.

WOULD REGULATE HEAVY TRUCKS

Stronger and more expensive road construction is necessitated by the increase in traffic, and especially by the weight of traffic. Most of the bridges were built when the heaviest load anticipated was a farm wagon carrying 3 tons. In the opinion of the commission, the users of such vehicles as a 6-ton motor truck carrying a 7-ton load neither make nor save enough money to justify the damage caused by them. In one day these trucks often ruin enough road or damage bridges to an extent that will more than offset the whole value of the truck and its potential work. Few of the towns can afford to reconstruct their roads for such heavy units. Six or seven years ago no state highway was made strong enough to withstand this traffic and few are so built to-day. The commission believes that, at the most, not over 6 tons gross should be permitted to be moved over country and village roads or bridges. Even on city pavements a lower limit than the present 14-ton maximum appears desirable. Effective regulation should make the vehicle owner responsible for all damage caused to bridge or road, and the sum recovered used for reconstruction.

The demand for unskilled labor and the high wages paid by factories last year, combined with the return of reservists to Europe, not only increased wages but led

to a scarcity of labor in many places. Advertised bids of the board were 50 to 100 per cent higher than ever before. In several cases the commission did not award the contract. If conditions do not improve much larger appropriations must be made for reconstruction and widening of the old state highways, or they will be rapidly destroyed.

The construction of new highways will call for more money per mile, not only on account of advanced prices, but because, with traffic increase, they must be made wider and stronger. Either a shorter length must be constructed each year or more money be made available.

The commission has been unable to determine this differential and when, as a result, it should refrain from building. Since it is impossible to judge how long the present conditions will continue, the commission followed a middle course, letting contracts when the bids were only 40 to 50 per cent above 1915 prices, and delaying the work when the bids seemed excessive and the importance of the road did not justify the expenditure.

NEW CONDITIONS AFFECT CONTRACTS LET IN 1915

In 1915 the commission prepared specifications and let contracts for long stretches of average construction and a number of miles of expensive road. Also contracts were let for shorter stretches of road where the construction costs were very high, due to the large quantities of materials that had to be handled. Many of these contracts were let at extremely low prices, even for 1915. At that time \$2 was probably the prevailing price for 8 hours' work.

On all these contracts a large amount of work remained to be done in 1916. Early in the spring of 1916 it was difficult to secure laborers at \$2.40 a day, and in many places later in the year \$3 a day was paid. Even then it was difficult to secure and keep enough laborers to prosecute the work economically or expeditiously. Many contractors were losing large

amounts of money and both they and the commission were dissatisfied.

On account of these conditions the commission was convinced that it should be as liberal as possible with all contractors showing a reasonable disposition to push the work, and that it was not fair to extend the contracts at the existing prices. The commission felt, however, that it had no right to cancel contracts already in force, merely because wages had gone up, but rather that it should make all possible allowances. In some cases in order to get the road completed it seemed wise to extend the work and estimate it either as extra work under the contract or allow what the engineers considered a fair price on account of the increased cost of materials and labor.

At several times during the year the railroad embargoes on road materials delayed work, and at no time were the local quarries able to produce as much broken stone as was needed for road construction.

ROADS WIDENED TO 18 FEET

Both in new construction and in resurfacing main lines of traffic the hardened surface has been widened from 15 ft., the standard of a few years ago, to a minimum of 18 ft. on the straightaway and 21 ft. or more on the curves. All curves have been banked, where possible, with a pitch of from $\frac{3}{8}$ to $\frac{3}{4}$ in. per foot of width. Shoulders 3 ft. wide are standard and less crown is built up than formerly.

On many main lines where the road has been resurfaced it has been necessary, because of the heavy motor traffic, to put in a new foundation, although the old construction had lasted 10 or more years under previously prevailing traffic. In the construction of all main lines the design has been strengthened. All conditions have conspired to increase construction, reconstruction and maintenance costs.

On Cape Cod, where the traffic is usually light in weight, though dense, the commission has continued to construct roads made of sand, heated and mixed with a hot asphaltic oil. Some of these roads, built six or



DARK AREA SHOWS MOISTURE DUE TO LACK OF PROPER DRAINAGE

more years ago, are still in a satisfactory condition. The same construction has been used both for widening old macadam road and for a 2-in. wearing surface.

On roads where heavy traffic was anticipated, both the penetration and mixing specifications were used. On grades the commission has continued in many places to grout the top course of 3-in. stone with a hot mixture of tar and sand, leaving the surface rough, hoping that it will prove less slippery for horses. In some places the bituminous surface cost has been omitted for this reason. While this may help for a time, the commission fears that the road surface will eventually ravel or disintegrate due to the penetration and freezing of water.

CONCRETE RECEIVES ATTENTION

On main lines the commission has more and more each year favored the building of cement concrete roads, noting the increased mileage and satisfactory service of this type of construction in the West and in New York and Connecticut. The commission has not felt, however, that even on main lines it should substitute cement concrete for all other forms of construction. It has built a good many miles of concrete roads and is building more yearly where the traffic is likely to be heavy and where the road can be closed absolutely during construction. In reconstructing the older state highways where a new foundation is found necessary, it frequently seemed advisable to substitute a concrete road, but where 2 or 3 in. of the old road remains well compacted, and not broken through, it has proved more economical to use the old roadbed as a base and resurface with some form of bituminous top.

All concrete roads have been made at least 18 ft. wide, and extreme care has been taken to provide for adequate drainage and foundation. Usually a 1:1½:3 mix is used, though occasionally a 1:2:4. All sections are at least 5 in. thick at the sides and 7 in. thick in the center. Where conditions are not of the best, these dimensions are increased by an inch. For the last two years hydrated lime has been incorporated in all concrete. The specifications call for materials of the highest grade and the commission feels that its inspection is adequate.

MAIN ROADS WIDENED AND IMPROVED

While building stronger and more expensive roads where traffic is heavy the policy of the commission has been to attempt to get the main routes widened and



SCARIFIER THAT PROVED EFFECTIVE ON MASSACHUSETTS ROAD WORK

improved so that they can be used in safety and comfort at least during the summer. In the western portion of the state, where the traffic is light and mainly motor driven, this has constituted the main part of the work.

During the year ended Nov. 30, 1916, the commission completed work on about 31 miles of state highway. Construction was begun, but not completed, on over 17 miles of roads in 18 municipalities. Layouts were made of 54.47 miles of state highway in 39 cities and towns.

MUNICIPALITIES AND COUNTIES CO-OPERATE

Particularly during the last two years the counties and municipalities have co-operated and built connecting roads, or made appropriations to aid in improving the main routes. Appropriations two or three times larger than those of former years are now common and nearly one-half of all the municipalities have made appropriations for the purpose of improving through routes. The commission hopes that the time will come



A STRETCH OF GRAVEL AND ASPHALT SURFACING

when the counties will appropriate enough money to match all the motor vehicle fees that are available for co-operative construction.

Requests of municipal authorities for engineering advice are numerous and in all cases the commission sends an engineer to look over the ground. Under certain conditions the commission furnishes plans and specifications, advertises the contract, and arranges for the supervision of the work. Almost invariably the advice of the commission and its engineers is followed by the local authorities. In this manner engineering advice was furnished forty-three municipalities in 1916. The law now requires that specifications for the construction of municipal ways be approved by the commission before the municipality can borrow long-term money for the work. Under this statute eighteen municipalities presented specifications for approval in 1916.

ROAD CONSTRUCTED BY CONVICT LABOR

In 1915 convict labor was used in improving the highway from Princeton Village to the foot of Mt. Wachusett. About forty convicts were maintained at the camp, an average number of twenty-six being used on the road. In five months this gang built 7500 ft. of macadam road 14 ft. wide at a cost of \$5,175. The macadam was compacted with a horse roller to a thickness of 8 in. at the center, tapering to 6 in. at the

sides. The county was allowed \$1 per day for each convict furnished. Foremen received \$2.50 per day. No overhead charges were figured in the above cost. This work was continued in 1916, appropriations totaling \$7,000 being available. Within a limited field the commission finds such work desirable.

RESURFACING AND WIDENING

About \$1,415,000 was available in 1916 for maintenance, widening and resurfacing. The report of the commission states that as much again could be expended with good results.

Over 3,800,000 gal. of various tar and asphalt products were used in construction and for surface treatment and patching. During the year 51.5 miles of state highway were resurfaced and 23.5 miles were widened but not resurfaced. Forty miles were widened and resurfaced at a cost of over \$657,000, of which widening alone absorbed over \$156,000. The resurfacing, therefore, cost nearly \$10,000 per mile. This large expenditure was due to the high cost of labor and materials and to the reconstruction and foundation work necessitated.

TREATMENTS WITH LIGHT OILS AND TAR

Over 600 miles of the older state highways were coated with light oils or coal tars at a cost of about \$274 per mile. Most of the roads had been coated in former years, so that only from 0.2 to 0.25 gal. per square yard was required, with only a small quantity of sand or gravel as a covering. In a few cases heavy traffic necessitated a second application during the season. Including 700 to 800 miles of the older type of state highways the total cost of maintenance was from \$620 to \$650 per mile. A still greater amount of work needs to be done in 1917 because of work slighted during 1916 on account of the high level prices.

Ordinary maintenance, including the wages of the section men, cost \$125 and patching, \$155 a mile. The first item fairly represents the average for the 1155 miles of state highway. The cost of patching the older highways averaged about \$220 to \$250 per mile.

COMMISSION RECOMMENDS LEGISLATION

The commission's recommendations include legislation to enable the state to secure the money appropriated by the federal government for the improvement of rural highways and post roads; to authorize the commission to appoint a motor-vehicle commissioner to relieve the board of many routine matters relative to automobile licenses and traffic; to authorize the assessment of a special betterment tax on the adjoining land when it receives special benefit from the road maintenance, and that the state appropriate annually not to exceed \$50 a mile to maintain trunk roads through towns of less than \$3,000,000 valuation, but that none of the funds so accumulated shall be used in towns whose valuation per mile of road, exclusive of state highways, exceeds \$50,000. A compulsory, graded and co-operative payment by the benefited towns is requested. The commission further suggests that an act be passed in 1917 appropriating \$5,000,000 to be used in the construction of highways in the 5-year period beginning with 1918. Automobiles pay about \$1,500,000 a year toward maintenance of through roads.

The total length of state highways at the end of the year was 1154.98 miles, and the total expenditures by the commission for the construction of state highways since the work began, including tree-planting, is \$11,643,799. The counties repay to the state one-fourth of the cost of constructing these highways. On Sept. 30, 1916, the total amount of bonds issued was only \$10,002,000. The sinking fund established to extinguish these bonds was \$3,057,768, leaving a net debt of \$6,944,232. The commission feels safe in saying that the state highways could not be replaced in the condition they are now in, although some are over 20 years old, for considerably more money than the net debt, and it doubts if they could be replaced, with the increased cost of labor and materials, for the gross amount of the bonds now outstanding.

Largest Pit in the World Used to Submerge Coal for Storage

Spontaneous Combustion Prevented in 100,000-Ton Pile—Concrete-Lined Reservoir Has Waterproofed Joints

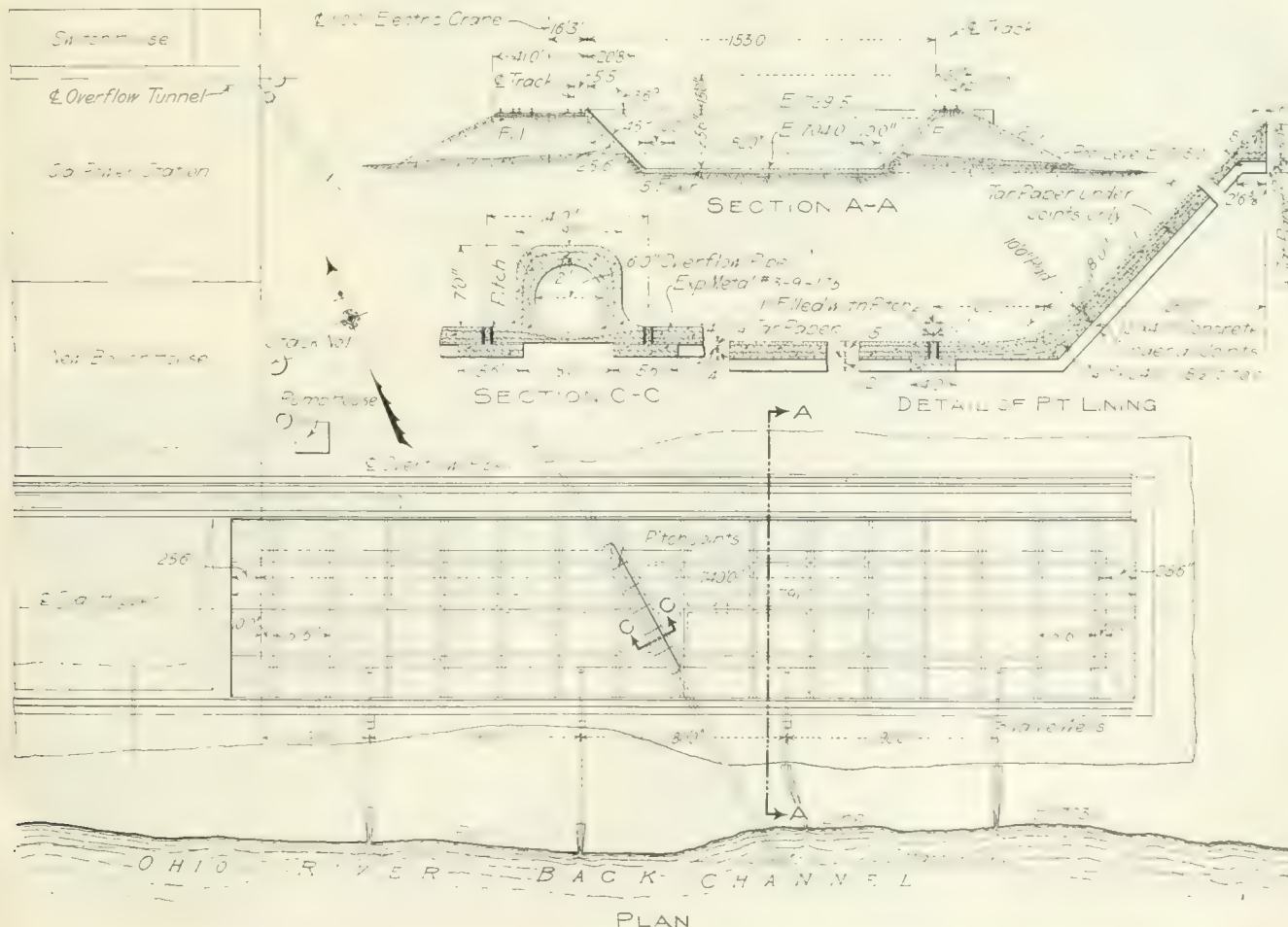
A HUGE PIT, 150 x 800 ft. in plan and 25 ft. 6 in. deep, with 45-deg. side slopes, will provide the Duquesne Light Company of Pittsburgh with safe storage space for a 100,000-ton pile of coal. The danger of spontaneous combustion will be prevented by submerging the coal in water up to the top of the pit, which is located near the company's main generating

plant on Brunot's Island. The concrete lining was laid in blocks about 40 x 50 ft. in size, separated by construction or expansion joints waterproofed by pitch and tar paper above a 12-in. base of concrete 4 ft. wide. In lining the side slopes, traveling structural-steel frames were used to support the unit timber forms. Another special feature was the method of overcoming difficulty in keeping the 1-in. expansion joints clear while concreting slabs by adopting thin steel plates held in place by iron pins and clamps.

DESIGN OF PIT AND CONCRETE LINING

As illustrated by the accompanying plan and sections, the top of the reservoir is 153 ft. wide and 791 ft. long, and the depth is 25 ft. 6 in., so that with a surcharge of 15 ft. the capacity is about 100,000 tons of coal. The floor is paved with concrete 15 in. thick reinforced by two layers of expanded metal. The 45-deg. side slopes on the inside of the embankment forming the sides are paved with concrete reinforced by expanded metal and cast monolithically with a bottom section 10 ft. wide, using curved reinforcing rods at the intersection, as shown in the detail drawing. The thickness of the side slopes varies uniformly from 20 in. at the bottom to 8 in. at the top. The outer slopes of the embankments are protected by riprap built up of one-man stone.

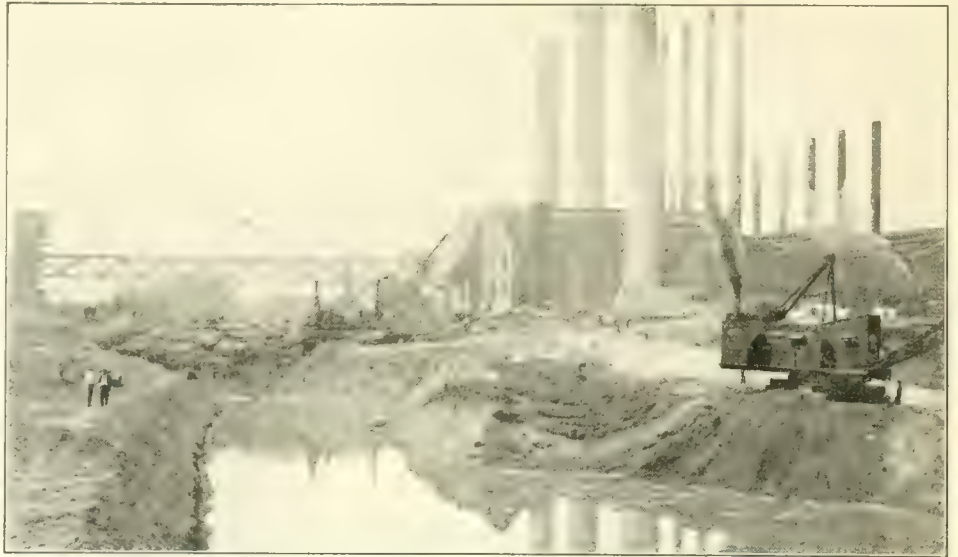
Water for submerging the coal is pumped into the reservoir through a 14-in. cast-iron pipe line leading from the power house to four 12-in. cast-iron outlet pipes placed 160 ft. apart in plan and about 6 ft. below the



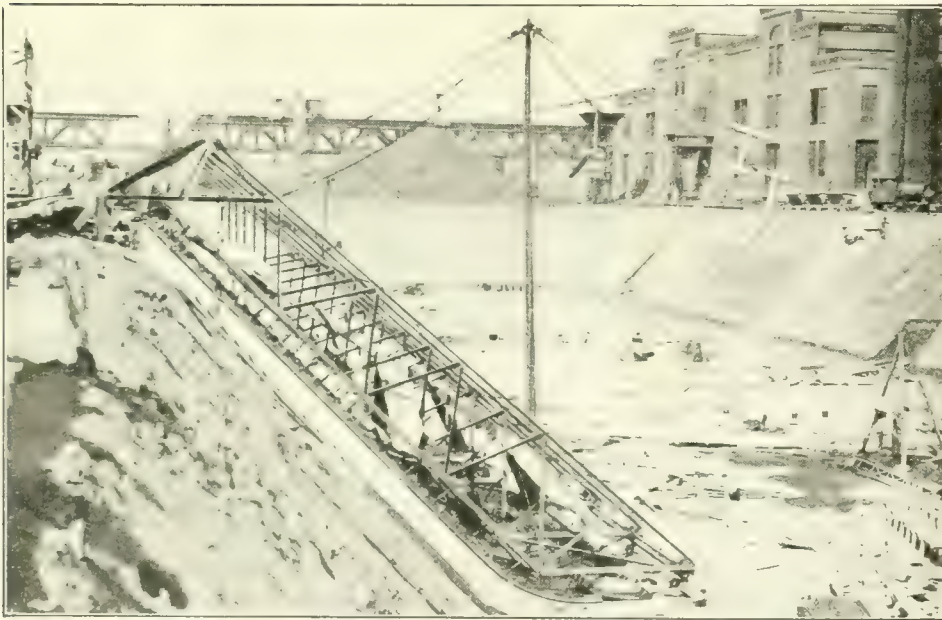
PLAN AND SECTIONS OF HUGE COAL-STORAGE RESERVOIR—DETAILS OF WATERPROOFED EXPANSION JOINTS

top of the reservoir. The 6-ft. concrete overflow pipe shown on the plan is in no way connected with the water system of the new reservoir, but was already in place when construction was commenced. The special covering of reinforced concrete shown on the drawing was designed to protect it from injury.

In order to prevent upheaval of the floor by uplift pressure if the pit were empty during flood conditions in the river near by, the drainage system, consisting of four 18-in. pipe lines located as shown on the plan, is equipped with check valves. These



EXCAVATION MADE IN TWO LONGITUDINAL CUTS BY DRAGLINE EXCAVATOR



CONCRETE FOR SLOPED SIDES PLACED BY USE OF STEEL TRAVELING FORMS

valves permit the water to rise inside the pit as the river rises in times of flood. The normal water elevation is at the level of the 15-in. concrete floor of the pit.

Details of the special expansion joints are indicated on the drawing. These joints are placed about 51 ft. apart longitudinally and extend entirely across the base and sides with three longitudinal joints 41 ft. apart, as shown in the plan. Some difficulty was experienced in keeping clear the 1-in. open joints which receive the soft pitch between the concrete sections. The scheme finally adopted, which proved satisfactory, was to place 18 x 1½-in. steel

plates 6 ft. long in vertical position along the curbs of the previously constructed sections and hold them in place by clamps over the top of the curbs, spacing them, to give the required 1-in. opening, by the use of round iron hook pins on 12-in. centers. These pins were easily removed after the floor slab had been cast. The steel plates, well oiled before placing, were then quickly taken out for use in a new joint.

The excavation for the pit was made by a Bucyrus dragline excavator running two longitudinal cuts, the greatest depth of cut being 25 ft. At the east end embankments were required. The material



LAYING SECTIONS OF 15-INCH CONCRETE FLOOR SLABS 51 X 41 FEET BETWEEN JOINTS

for these was obtained by moving the excavated earth from the west end in 4-yd. dump cars.

A central concrete plant located on the river bank adjacent to the work was used to supply concrete for the pit and also for the construction of two large intake wells being built at the same time about 100 yd. away. Gravel and sand for the concrete were obtained in barges along the river and were hoisted directly into a bin with a capacity of about 150 yd. which fed a $\frac{1}{2}$ -yd. Haines mixer, from which the concrete was elevated by a tower and a part placed directly in position by a system of chutes. The remainder of the concrete was loaded into specially designed side-discharge cars and transported to points from which, by means of chutes, it could be placed in position.

SPECIAL STEEL TRAVELING FORM EMPLOYED

It was found necessary in order to retain the concrete on the 1 to 1 slope to use a special steel traveling form, designed and built by the Blaw Steel Construction Company, consisting of six trusses resting on rollers and traveling on single rails, one at the top and one at the bottom of the slope. The face forms proper were made of wood in removable panels about 3 x 10 ft. in size and were attached to angles by lugs, the angles being suspended from the trusses by rods fitted with turnbuckles to allow adjustment to proper alignment.

The pit, located near the main generating plant of the Duquesne Light Company on Brunot's Island, Pittsburgh, is being constructed by the Duquesne Contracting Company of Pittsburgh, of which J. J. Emes is superintendent and C. W. Gibbs, chief engineer. The design was made and construction supervised by F. Uhlenhaut, Jr., chief engineer of the Duquesne Light Company.

Use Home Materials for Road Work

Frank T. Sheets of Illinois Highway Department Urges Examination of Local Sources to Avoid Costly Long-Distance Haulage

GRAVEL and crushed stone are very heavy, their transportation is costly, and every endeavor should be made to ascertain whether suitable material can be obtained locally before they are imported at heavy expense, says Frank T. Sheets, assistant maintenance engineer of the Illinois Highway Department, in *Illinois Highways*. The surfacing of a road costs more than most people believe. In the case of eighty-seven gravel roads, the grading and drainage averaged 41 per cent and the surfacing 59 per cent of the total cost; in 104 waterbound macadam roads, the grading and drainage cost 35 per cent and the surfacing 65 per cent. In fifty-three bituminous macadam roads, these proportions were 27 and 73 per cent. These figures show, as interpreted by Mr. Sheets, that more than half the cost of a surfaced road is generally spent for the materials and labor employed in surfacing the graded and drained roadbed.

Usually the engineer is too busy to do much searching himself, but he can obtain much assistance if the local authorities will make systematic endeavor to ascertain the location of all ledges, sand banks and gravel beds in their neighborhood. These are public resources of real importance, and should be a matter of record.

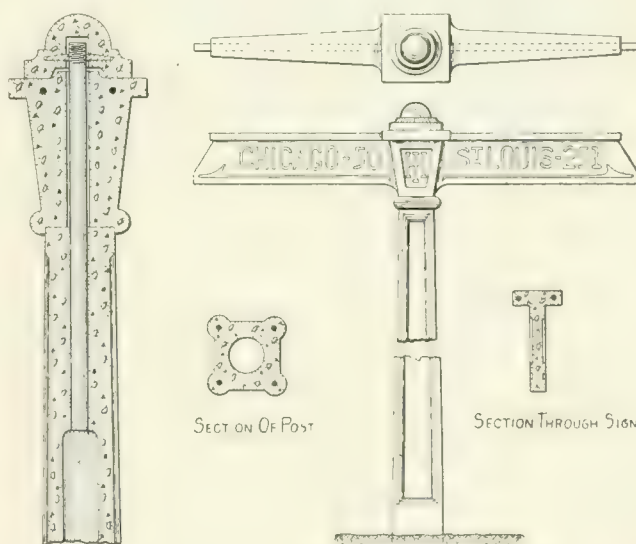
In some communities school children have been encouraged to search for them, and in many places local amateur geologists and mineralogists have done a public service while riding their hobbies. There can be no question that the lack of complete knowledge of this nature is needlessly increasing the cost of road construction and maintenance in many parts of the country.

Concrete Road Sign Wins Prize

Illinois Highway Commission Selects Design of W. H. Lienesch from Seventy-five Submitted in Competition

THE official state-aid road sign for Illinois has been chosen. The design for it was submitted by W. H. Lienesch, chief engineer for the Universal Concrete Products Company, Chicago.

Competition for the prize, which the State Highway Department posted in an announcement last June,



THIS IS THE DESIGN WHICH WON THE PRIZE COMPETITION FOR ILLINOIS ROAD SIGNS

brought designs from about 75 competitors throughout the United States, from California to Massachusetts. It was stipulated that the drawings should illustrate the proposed type of sign, to be erected along all state-aid roads.

The accompanying illustration shows Mr. Lienesch's design. It was selected by the State Highway Commission, the Chief State Highway Engineer and approved by Governor Dunne because of its simplicity and durability, and its evident ability to serve the purpose to which it will be put. The sign is of concrete construction.

Concrete Road Contracts in 1916

Figures furnished by the Portland Cement Association show that contracts awarded for concrete pavements up to Dec. 1, 1916, reached a total of 24,929,148 sq. yd. Of this total 16,533,129 sq. yd. are roads, 7,501,739 sq. yd. are streets and 894,280 sq. yd. are alleys. There remain to be collected and tabulated the contracts for December which will make the 1916 total exceed 25,000,000 sq. yd.



Lakewood's Business Streets Paved with Concrete

Thirty-Four-Foot Width Requires Two Templates Supported at the Center by T-Bar and Pins

By J. C. BENTLEY

Engineer and Contractor, Elizabeth, N. J.



STRIPS ON BOTTOM OF LOADING SKIP OF MIXER ALLOWED SCOOP CARS TO BE ROLLED UP ON TRACK AND DUMPED

AT Lakewood, N. J., there was recently completed the first permanent pavement laid in that town. After a careful investigation by members of the township committee a reinforced-concrete pavement without surface treatment was selected and the two main business streets, Clifton Avenue and Second Street, were paved with this material. The Clifton Avenue pavement, four blocks of 350 ft. each, was 22 ft. wide upon each side of a 9-ft. parkway. A 5-in. integral curb was constructed when the pavement was laid. Second Street was 34 ft. from curb to curb, and the improvement extended over three blocks of 600 ft. each. The work included, also, concrete curbs, catchbasins and drainage.

MATERIAL STOCKED AT INTERSECTING STREETS

Because of the scarcity of labor and anticipated difficulty in obtaining material promptly, and also to cause as little inconvenience to the business men along the two streets as possible, a method of construction not ordinarily used was decided upon for this job. Sand and stone were stocked at the intersecting streets at four places for the Clifton Avenue work and at three places for use upon Second Street. The streets selected were wide enough in all cases except two to permit stocking of material in the center, allowing traffic to pass on each side. Orders for sand and stone were placed as soon as the contract was signed, and these materials were being received and stocked while curb, basins, drainage, etc., were being constructed. Had material been dumped upon the sub-grade to be handled, as is usual, the streets would have been closed weeks in advance of beginning work.

The concrete was mixed in a self-propelled Chain-Belt batch mixer of 20 cu. ft. capacity, equipped with a delivery boom and bucket. To deliver material from stock piles to mixer scoop cars of 18 cu. ft. capacity, running on light 24-in. gage portable track, were used. The longest haul was 700 ft. upon Second Street and 400 ft. upon Clifton Avenue. The track was laid in the center of the street, upon the finished subgrade,

extending under the mixer, a section being removed as the mixer moved ahead. Upon the bottom of the loading skip two iron strips were bolted. These strips extended about 12 in. over the edge of the skip, and when the latter was lowered the iron strips rested upon the top of each rail, allowing cars to be readily run into the skip and dumped.

The cars were first loaded with the required amount of sand, then filled with stone, and hauled in trains of two cars by a horse and man to the mixer. Each car contained one batch. The cement was hauled direct from railroad cars to the job by the use of two skid wagons and one team with driver and helper. One wagon was left at the mixer, from which the cement man handled cement into the skip while the team with the extra wagon went after another load. This method not only saved labor expense but also loss of bags due to extra handling. Hauling also was done with a home-made tractor-trailer outfit, described in the "Hints for the Contractor" section, page 200.

HOW CONCRETE WAS SHAPED

The laying of the pavement upon Clifton Avenue presented no difficulties. Side forms level with the top of the integral curb along the parkway were set and the concrete struck off with a template resting upon the top of this form and upon the top of the curb. Afterward an inside form was hung from the side form and concrete was placed to form the parkway curb. Expansion joints were placed every 36 ft.

Upon Second Street pavement was laid from curb to curb, 34 ft., without longitudinal joints. To accomplish this two templates shaped for one-half of the street and constructed of 2-in. material, shod with iron and provided with iron handles upon each end, were used. These templates were run upon the top of the concrete curb at the sides and upon a screed or false center set parallel to the curbs in the center of the street. This screed was a 3-in. T-bar, 16 ft. long. Its flange was cut back at each end to permit the cutting of a slot 1 in.

wide and 3 in. long through the back of the T at the ends. This slot permitted the screed to be placed over iron pins upon which nuts securely held it at the proper elevation. These pins were about 30 in. long, threaded upon one end for two nuts; the other end was sharpened. About 18 in. from the point a shoulder had been formed upon the pins which, with the aid of washers 3 in. square, prevented any settlement after the stake had been driven into the subgrade. In sand it was found necessary to use wooden washers 8 in. square under smaller washers to prevent settlement. These pins were driven into the subgrade along the center line of the street 15 ft. 6 in. apart, ahead of the first layer of concrete. After reinforcement had been embedded in the concrete the screed was revolved to the pin ahead, adjusted to proper grade by use of nuts upon the pin and the top layer of concrete placed and struck off with templates. One side of the street was kept a little in advance of the other. This method worked very satisfactorily and a true and uniform surface resulted.

The usual wooden floats were used to float concrete. These were operated from bridges made from 2 x 12-in. yellow pine plank 36 ft. long arched with $\frac{1}{2}$ -in. rods and turn-buckles upon bottom and an occasional strut from rods to plank for the Second Street work. As many as six men have been seen upon one of these bridges at one time. Exceptionally good results were obtained in floating by the use of a mason's "darby." This was a float about 4 in. wide and 5 ft. long, constructed from light wood $\frac{1}{4}$ in. thick. It had a handle upon each end, and was similar to the long redwood floats used upon the California highways. Besides the split float at joints a curb template was used to insure a uniform curb face.

100 CUBIC YARDS PLACED DAILY

The concrete was proportioned approximately 1:2:3, the exact proportioning depending upon voids in the graded stone. A batch consisted of 18 cu. ft. of sand and stone and 4 bags of cement. The pavement, 15,000 sq. yd., was 7 in. thick throughout and reinforced with American Steel & Wire Company No. 28R mesh, weighing 34 lb. per 100 sq. ft. Pittsburgh paving joint was used at all expansion joints and along each curb. A day's work averaged 100 cu. yd. of concrete mixed and placed. On several days 125 cu. yd. were handled in 9

hr. with a crew of 22 men and foreman. Local men and foremen were employed throughout, although none had ever seen a concrete pavement before. No delays because of non-arrival of material were experienced after concrete mixing was started, and altogether the method employed proved very satisfactory, although doubtless somewhat more expensive than had the mixer been charged with wheelbarrows.

ACCEPTANCE CEREMONIES

To have one's work publicly accepted has seldom been the experience of road contractors. As an appreciation of the good work done by the contractor, Nov. 28, 1916, was proclaimed in the town as Acceptance Day. Upon



A T-BAR, SLOTTED AT ENDS, WAS HELD IN PLACE BY ADJUSTABLE PINS TO CARRY ENDS OF TEMPLATES ON STREET 34 FEET WIDE

that day there was a parade consisting of the several motor-equipped fire companies, local societies and orders, bands and all the school children. All buildings on the improved streets had been decorated. The streets were presented to the township by the contractor and accepted by their counsellor. H. K. Bishop, of Vermeule & Bishop, New York City, now district engineer, U. S. Office Public Roads, Washington, D. C., was engineer for the township, and the writer was the contractor.

Fines for Heavy Loads on Soft Gravel Roads in Indiana

As a measure of protection for its gravel roads the Indiana legislature has passed an unusual "wet-weather law," imposing fines for the use of vehicles carrying excessive weights on narrow tires. At times when the roads are softened by water any person hauling more than 2500 lb. on tires less than 3 in. wide, more than 3000 lb. on 3 to 4-in. tires, more than 3500 lb. on 4 to 5-in. tires, and more than 3800 lb. on tires 5 in. or over is liable to a fine of from \$5 to \$50 for each load hauled. Such a law in itself, the American Highway Association points out, is not likely to be very effective, so the statute also gives the local road officials police power to arrest any offender against this law, and to encourage such arrests the official must be paid a fee of \$2 for each person he arrests who is convicted. This law is directed against damage to the roads through misuse, but many roads are damaged by neglect as well, and so the Indiana lawmakers have provided that any local road official who does not maintain the bridges and highways in his charge in as good condition as the means at his disposal permit shall be fined from \$5 to \$100.



SCOOP CARS ON NARROW-GAGE RAILWAY DELIVERED MATERIALS TO MIXER

Colt's Plant Completed on Schedule Time

Story of Erection of 11-Acre Building for Hartford Manufacturing Firm Proves Organizing Genius of Modern Concrete Contractor

PLANNED to the last detail—the very number of workmen needed at each step and the means and time of delivery of each item of material known in advance—the construction of a large reinforced-concrete building for the Colt's Patent Fire Arms Manufacturing Company, of Hartford, Conn., was recently carried out in accordance to the day with a previously published progress schedule. The builders, the Aberthaw Construction Company, of Boston, did not reach this result by elaborate or unusual procedure, and but three months elapsed between the owner's decision to build and the completion of the four-story frame inclosing a floor area of 11.2 acres. Indeed, the only departure from the firm's customary practice in handling the work is stated to have been the advance publication of its progress schedule. The story of the planning and execution of this achievement is one of the application of hard common sense, with accuracy of detail but without delay of red tape, to the problem in hand.

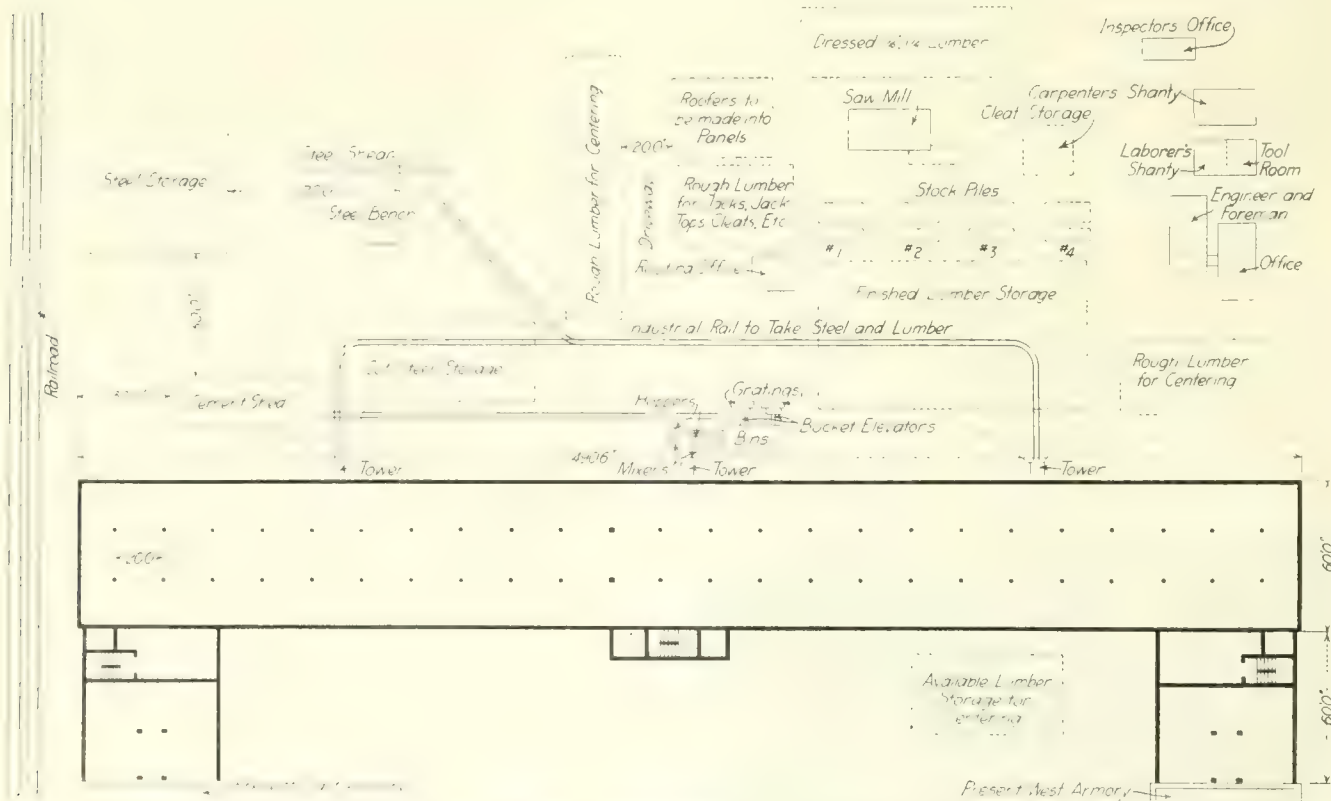
By telephone appointment the contractors' engineers met the owners' representatives and the architects,

the building department of the owners, bought all labor and materials, made all subcontracts and charged up everything at cost. For their executive services and profit they received a commission.

PLANS AND WORK START TOGETHER

The architects immediately began on the plans, the contractors made up a probable square-foot-of-floor cost, began the clearing of the site and digging of test pits, and secured bids on footings and pile foundations. Coincidentally, after a quick but thorough survey of local conditions, such as the available vacant land, the railroad siding, the probable streets along which materials could be delivered, and nearby sources of materials that would be required, the engineering department made its first plant layout. Bins, sheds and office buildings were located and a place allotted for every class of material arriving on the job. This layout was subsequently perfected in the complete plan reproduced herewith.

At the next weekly conference of the contractor's staff the entire job was taken up for discussion and



LAYOUT ADJUSTED TO DELIVERY ROUTES, REQUIREMENTS OF CONSTRUCTION AND SPACE AVAILABLE

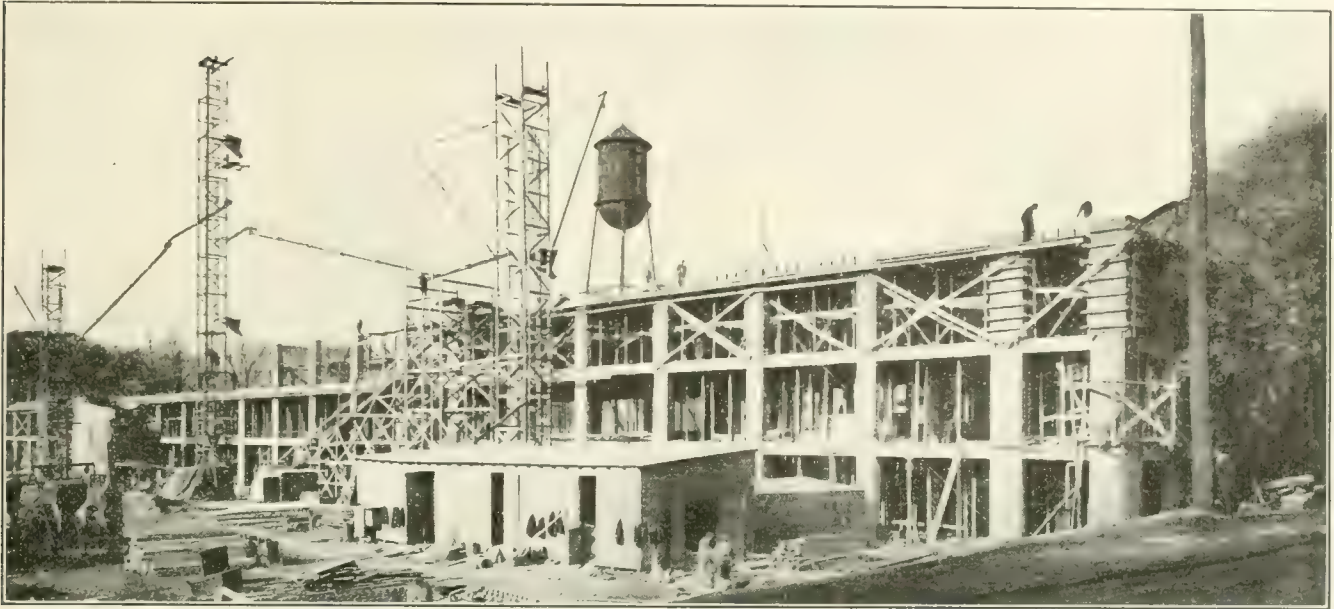
Monks & Johnson, at Hartford on Monday, Aug. 21, 1916. The location and size of the building were there decided, and the conditions under which it should be built were arranged between the owners and the contractors. The work was undertaken upon a cost-plus-profit agreement, the same as on a previous building recently completed. The contractors became in effect

definite organization. At this conference were present the man who secured the contract, two general superintendents, the chief engineer, the purchasing agent and the schedule engineer. The manager, who usually presides, was absent. The building superintendent was selected, together with his principal assistants, the carpenter, labor and planning foremen, the engineer

and the master mechanic. The discussion covered plant layout, including number and location of mixers, method of distributing concrete, purchase and handling of lumber for forms, requirements in the way of steel and cement, prices and deliveries on these materials, architects' drawings, tentative progress schedule and many minor questions. Each man left the conference bearing definite responsibility for his part of the work.

The tests of the soil resulted in a decision to use piles, and the contract was given to the Raymond Concrete Pile Company. Two pile drivers were ordered on the job. In the shipping of one, which came from

which drawings must be in hand, and requirements in the way of form lumber, steel, cement, etc., were furnished to the purchasing agent. His responsibility ended when he had placed the order subject to specific deliveries. The superintendent on the job, being informed of the conditions of these orders, thereafter assumed responsibility for direct following up of the requirements. Any cases which he could not handle were referred back to the traffic department of the main office. Finally, cases which were beyond the power of the regular staff to straighten out were turned over to the manager to take up with the principal authority



PHOTOGRAPHS TAKEN ON DATES GIVEN IN ANNOUNCED PROGRESS SCHEDULE SHOWED WORK ADVANCED TO SPECIFIED LEVELS

Boston, the Aberthaw company materially assisted their subcontractors in making quick time.

As a basis for all operations the schedule engineer immediately perfected his progress schedule, which is given in Table 1 in so far as it covers the direct work of the contractors.

Between the schedule engineer and the chief engineer the architects were kept informed as to dates upon

in the outside organization. In the case of subcontractors who were manufacturers, schedules were furnished and close touch was kept with the dates of beginning work and shipping the finished products ordered.

The situation was complicated by the New England freight embargo, but by having some source of supply or some method of handling always in reserve all serious delays were avoided. Plant, equipment, small tools

TABLE 1 PROGRESS SCHEDULE

Item	Start	Finish	Forms	Start	Finish
Clearing of site.....	Sept. 4	Sept. 16	Footings and foundation walls.....	Sept. 16	Oct. 8
General excavation.....	Sept. 11	Sept. 20	Make columns, floors and bins.....	Sept. 25	Oct. 11
Footings and foundation walls.....	Sept. 18	Oct. 5	Erect columns.....	Oct. 6	Nov. 21
Rolling for paving.....	Sept. 14	Sept. 25	Erect floors and roof.....	Oct. 6	Nov. 21
Backfill and grading.....	Sept. 26	Oct. 5	Erect Beams and slab.....	Oct. 6	Nov. 21
Driving of piles.....	Sept. 14	Oct. 16	Erect wall beam.....	Oct. 6	Nov. 21
Test pits.....	Sept. 1	Sept. 16	Erect parapet.....	Nov. 15	Nov. 29
Concrete					
Footings and foundation walls.....	Sept. 20	Oct. 7	Sills and coping.....	Nov. 6	Dec. 14
Paving.....	Sept. 28	Oct. 10	Stairs.....	Oct. 25	Dec. 14
Floors and columns.....	Oct. 6	Nov. 23	Penthouse.....	Nov. 15	Nov. 25
Stairs.....	Oct. 28	Dec. 7	Unload lumber.....	Sept. 5	Oct. 5
Sills and coping.....	Nov. 7	Dec. 12	Strip columns.....	Oct. 13	Nov. 25
Parapet.....	Nov. 18	Nov. 25	Strip slabs.....	Oct. 18	Dec. 5
Penthouse.....	Nov. 18	Nov. 25	Steel sash—Unload.....	Nov. 6	Nov. 18
Granolithic finish.....	Nov. 6	Dec. 9	Steel sash—Erect.....	Nov. 7	Dec. 12
Carborundum rub.....	Oct. 13	Dec. 5	Steel sash—Grout.....	Nov. 8	Dec. 16
Cinder roof.....	Nov. 18	Nov. 30	Masonry		
Unload cement.....	Sept. 7	Nov. 22	Unload brick and tile.....	Oct. 16	Nov. 30
Unload sand.....	Sept. 16	Nov. 22	Lay tile.....	Oct. 30	Dec. 9
Unload stone.....	Sept. 16	Dec. 5	Lay brick.....	Oct. 25	Dec. 9
Unload, erect and dismantle plant.....	Sept. 2	Dec. 16	Staging and plant.....	Oct. 20	Dec. 13
Steel Reinforcing					
Unload.....	Sept. 11	Oct. 11	Plastering.....	Nov. 6	Dec. 20
Bend and place columns.....	Oct. 5	Nov. 22	Door frames, girders and sills.....	Oct. 25	Dec. 10
Bend and place footings and walls.....	Sept. 16	Oct. 7	Doors and hardware.....	Nov. 15	Dec. 16
Bend and place floor.....	Oct. 5	Nov. 22	Inserts.....	Oct. 9	Nov. 25
Bend and place beams.....	Oct. 5	Nov. 22	Sleeves.....	Oct. 9	Nov. 25
Bend and place miscellaneous parts.....	Oct. 5	Dec. 15	Scuppers.....	Oct. 9	Nov. 25
			Miscellaneous iron work.....	Oct. 15	Dec. 15
			Clean up job.....	Dec. 21	Dec. 30
			Watchman.....	Sept. 14	Dec. 30
			Overhead.....	Aug. 30	Dec. 30

and stationery scheduled by the building superintendent on a blank furnished for that purpose were immediately shipped. In accordance with the plant layout offices and storehouses were shipped from the contractor's yard, each building being made of standard sections 15 ft. wide in 10-ft. lengths.

The order for cement was placed, the storehouse was filled in advance of requirements, continuous shipments from the mill were maintained, and arrangements made with a local dealer so that his stock could be drawn upon in case of emergency. Sand and gravel were con-

cause of the close proximity of the mill, and the fact that others stood ready to meet the requirements, daily deliveries were made and only a limited supply of lumber was kept on the ground.

To start the job reinforcing steel was shipped from the Aberthaw yard in Boston. With the exception of a few local emergency purchases handled by truck or auto there was no tie-up on account of steel, notwithstanding the freight embargo.

In the matter of labor the company's usual policy of transferring men from other jobs where they could



DURING PROGRESS OF JOB VERTICAL LINES SHOWED DATES, WHILE CRAYON LINES REPRESENTED QUANTITY OF WORK DONE

tracted for locally and hauled from near-by banks, of which the number was sufficient to guard against a tie-up with any one contractor. The storage bins were kept filled and daily deliveries made direct to the mixers. All scheduled form lumber, cut to dimensions, was turned out by a local mill, delivered on the job and piled separately according to size, ready for use. Be-

be spared was maintained. Through the avoidance of hiring and discharging on the job the contractor has been able to build up an organization in which even the members of the shovel brigade average two years connection, while concrete laborers, steel men and carpenters remain three and four years in the service of the company. A material factor in holding men to-

gether is the maintenance of the same rate of pay no matter where the man is at work. The number of men employed on the job on each of the principal dates specified in the construction schedule is given in Table 2. These are grouped according to the character of the work.

The chart which graphically represents the dates and limits and serves as a basis for recording progress is reproduced herewith. Three blueprints of it are sent to the job, one for the superintendent, one for the routing department and a third to be brought up to date weekly and sent to the Boston office. Another copy is kept on the bulletin board in the Boston office, and is brought up to date weekly from the copy sent in by the job. On the blank blueprint each item of work is represented by a wide white line. When an item of work is started it is recorded on the sheet by drawing

TABLE 2 MEN REQUIRED BY SCHEDULE

	Oct. 6	Oct. 21	Nov. 2	Nov. 13	Nov. 23
Laborers (including steel men)	52	79	109	96	90
Labor foremen	7	7	9	8	5
Carpenters	17	31	44	46	28
Carpenter helpers	26	42	73	81	49
Carpenter foremen	5	6	6	6	6
Master mechanics and mechanics	9	16	14	15	15
Cement finishers		6	16	14	16
Masons and tenders			8	9	18
All others	18	21	12	25	21
Totals	165	208	291	300	248

a yellow line over the upper half of the heavy horizontal line. The length of the yellow line is made proportional to the amount of work done on that item, the entire heavy line representing volume rather than time, although it spans the period between the scheduled beginning and ending. It is therefore evident that the ratio of the length of the yellow line to the total length of the heavy line represents the proportion of the particular item of work which has been completed.

When work does not start on time a red line is drawn over the lower half of the heavy white line and is continued to the date when the work starts, when the yellow line is begun in its proper place. The red line therefore shows at a glance just how far behind work is upon the given item. Each week a piece of string is stretched vertically across the chart from the current date shown at the top of the sheet. If at any time the yellow lines extend beyond this string it indicates that the job is ahead of schedule on that particular item.

"FINISHED TO SCHEDULE"

Unusual attention was directed to the building by the advance publication of the proposed construction schedule and the issuing of periodic bulletins showing by photographs how it was being met floor by floor. Although the complete schedule was detailed nearly ten weeks in advance of the date of pouring the roof, the suggestion of publishing it was not made until some time later. Instructions were then given that work was to proceed exactly as on any other job. The principal dates in the construction schedule as published were as follows:

Oct. 6	Start superstructure
Oct. 21	Finish pouring concrete, second floor
Nov. 3	Finish pouring concrete, third floor
Nov. 13	Finish pouring concrete, fourth floor
Nov. 23	Finish pouring concrete, roof

After making the usual allowance for stormy weather the schedule showed forty-two working days for completing from foundations to roof the four-story concrete building, which is 490 x 60 ft., with a 60-ft. square wing at each end, and has a plan area of 2.8 acres. Although the work was actually completed in forty days, this was not due to speeding up, but merely to the fact that the anticipated number of stormy days did not materialize. In a word, the schedule was met to a day so far as the actual working period was concerned.

Thin Brick Reduces Paving Costs Nine Cents per Square Yard

Improvement in Construction Methods Claimed in the Use of Grout, Instead of Water, for Moistening Cement-Sand Cushion

By PARK H. MARTIN

Borough Engineer, Avalon, Pa.

NINE cents per square yard was saved in the repaving of California Avenue, Avalon, Pa., by reducing the depth of the brick blocks from 4 to 3 in., and what is believed to be an improvement over ordinary construction methods was inaugurated by moistening the cement-sand layer under the brick with grout instead of plain water, the latter having the tendency to wash the cement in the cushion layer from the top to the bottom, thus making a firm bond between brick surfacing and concrete foundation difficult to secure. Empowered by the council to buy all materials and engage all employees, the borough engineer had complete control over operations and was unhampered by politics.

ORIGINAL PAVEMENT 16 YEARS OLD

California Avenue is the main business street of the town. The average daily traffic comprises 1200 to 1500 automobiles, 300 trucks and 200 wagons. There is a double track street car line on the street, running to Pittsburgh, five miles distant, over which about 300 cars pass daily. The street car tracks are in the center of the street, with a space of about 10½ ft. between each track and the curb. The total width of the street between curbs is 36 ft., and 75 per cent of the vehicles travel on the part of the street between the car track and the curb, thus concentrating loads on relatively small portions of the paving.

The avenue was first paved about 16 years ago, the construction involving a 6-in. concrete base, sand cushion and wire-cut brick, with sand filler. The street had become filled with low places and holes, due to the foundation giving out and also to the bad effect of the street car tracks. Although the brick were badly chipped, they had not worn down on an average of more than ¼ to ½ in. The main fault was that the base of the street had played out.

3-INCH BLOCK RECOMMENDED

The fact that the brick had served 16 years and only worn down ¼ in. during a time when there had been heavy hauling with steel tired wagons led the writer to consider the use of 3-in. block. Observation showed that only 10 per cent of the present traffic is steel-tired, the balance being rubber-tired. This being the

case there was apt to be less wear on the brick in the future than in the past, and the writer finally recommended to council the adoption of a 3-in. block on a cement-sand cushion with a grout filler.

The old base was to be resurfaced and brought to grade with concrete unless it was found to be in too bad a condition; in such case it was then to be removed and a new concrete base laid. Not knowing the exact condition of the base—how much was good or bad or how much concrete would be necessary to bring it to grade—we did not see how a contractor could bid intelligently on the work, and it was decided that the borough could best do the work with its own labor. The borough engineer was given complete control. Bids were taken on 3-in. and 4-in. block, and as recommended by the engineer, 3-in. Dunn wire-cut-lug block were adopted. The contract was awarded to the Bessemer Limestone Company, of Youngstown, Ohio.

LABOR SCARCE

Labor was found to be very scarce, particularly because of the 5-mile ride to Pittsburgh and the fact that Avalon is purely a residential district. Labor was first paid 22½ cents per hour and worked a 9-hour day, but men could not be held at that rate; 25 cents per hour was then paid, but we met with indifferent success. Finally 28 cents an hour was paid and only the best of men engaged, but still labor was scarce and independent. Teams were paid \$6 per day of 9 hours.

As there were about 450,000 brick taken up and we had no particular use for them it was decided to advertise them for sale. Council granted permission to sell about 200,000 of the old brick; the balance were stored for use around the borough. The writer fixed a price of \$5 per thousand, the purchaser to haul the brick off the street. No trouble was found in disposing of the 200,000 brick to various people for drives, garages and chimneys. At this one stroke we salvaged \$1,000, besides saving the expense of hauling and piling, an item which would have amounted to at least \$1 per thousand. The foreman in charge of the work, who was an engineer, kept account of the number of square yards of brick taken up and hauled by any one purchaser; the number of square yards multiplied by 50 brick per square yard gave the number each received.

NEW BRICK COST \$15.50 PER THOUSAND

The new brick for the work cost the borough \$15.50 per thousand, f. o. b. Ben Avon Station, the nearest freight depot. They were hauled by four different draymen at the rate of from \$2.50 to \$2.75 per thousand. The haul was all uphill and about 1¼ miles in length to the middle of the work. The price, of course, included the labor of loading and unloading the brick from off the cars and at the street. We believe we have made a saving of about 9 cents per square yard in the cost of the paving, by the difference in price between the 3-in. and the 4-in. block and in the hauling, or a total saving of about \$720 over the 4-in. block. Tests of brick were made by the Pittsburgh Testing Laboratory, and the average result is as follows: Abrasion loss, 20.31 per cent; absorption gain, 2.66 per cent; crushing, 11,433 lb. per square inch. The specified requirements were: Abrasion, under 24 per cent; absorption, under 4 per cent; crushing, over 7500 lb. per square inch. All material met the tests.

Two brands of cement were used—Universal and Crescent. All cement was tested by the Pittsburgh Testing Laboratory at the factory and all proved satisfactory. Cement cost \$1.82 per barrel on the cars, and \$1.92 per barrel in our cement house, with 40 cents per barrel allowed for containers. We accepted the price of \$1.92 in the cement house, as the charge of 10 cents per barrel for hauling and unloading was as cheap as we could expect to do ourselves. Cement was all hauled by truck. The sand and gravel were purchased from the Rodgers Sand Company, of Pittsburgh, and was nearly all delivered by trucks from its Allegheny yard, a haul of about 4 miles. It was all river sand



GROUT, INSTEAD OF PLAIN WATER, WAS USED TO MOISTEN CEMENT-SAND CUSHION FOR THE BRICK PAVEMENT AT AVALON, PA.

and gravel, and the cost on the job was as follows: Sand, \$1.60 per ton; gravel, \$1.40 per ton.

Prepared asphalt expansion joints, ½ x 3 in., were laid along the curbs and cost \$2.13 per 100 ft., f.o.b. Ben Avon.

The Borough of Avalon owns a gasoline concrete mixer which it was the intention to use. It was found impractical, however, due to insufficient space between the car track and the curbs. The only way it could be used was by placing it on an intersecting street and hauling the concrete to the job. At some places the concrete was only 2 in. in depth and at others 4 in., and the space from the street car track to the curb was only about 10 ft. It was found, therefore, that the machine had to be moved too often to justify its use. The writer decided that hand mixing would be the cheapest and best. Accordingly a contract was made with James Very to lay the concrete base and also the brick. A price of 15 cents per linear foot of street 10 ft. wide was made for laying the concrete, without regard to depth. It proved to be a fair price and satisfactory to both parties. A price of 10½ cents per square yard was agreed upon for the work of making

the cement-sand cushion, laying the brick, and applying the grout filler. This was to include the brick culling, but we found that unless we culled the brick ourselves they were not culled.

Under this arrangement Very's men laid concrete one day and brick the next, the one operation always keeping pace with the other. A big advantage in this was that while the base was still green the cement-sand cushion could be laid, thus insuring a far better bond between the two than if four or five days elapsed between the time of laying the concrete and that of laying the cushion. The concrete was laid in the proportions of 1:3:5. It was found essential to use a fine grade of gravel known as pea gravel to obtain the best results due to the shallow depth of concrete necessary to re-surface the old concrete. In many places, however, as much as 6 to 7 in. of concrete was required to bring the street to surface, and the average over the entire street was 4 in.

CEMENT-SAND CUSHION

The cement-sand cushion was mixed dry, 1 part cement to 4 parts sand. The concrete base was first wet with a sprinkling can and then the cushion was laid. The cushion was shaped with a template and before the brick was laid it was sprinkled with a sprinkling can. Later in the work, the writer ordered that the empty cement sacks should be well shaken over the cushion after sprinkling and considerable cement was thus added to the top of the cushion. The brick were then laid and rolled. As a cushion of only 1 in. was laid, a 1000-lb. hand roller 30 in. in length was used and proved very satisfactory; it did not force the sand up between the brick and was quite a saving and convenience.

After rolling, the brick were culled, and then thoroughly wet with a hose. This was done partly to add water to the cement-sand cushion as well as to wet the brick. The grout was then applied in the proportions of 1 part cement to $1\frac{1}{2}$ parts of sand. The first application was wet enough to run freely into the joints of the brick. After about 20 to 30 min., a second and thicker application was made. The grouting was always the last thing done in the evening and the finished pavement was allowed to stand until the next morning.

PROTECTION SAND ALLOWED TO REMAIN A WEEK

The following morning, sand taken up from the old cushion was brought back and spread over the work finished the preceding evening. Several times during the day the borough street sprinkler would be hauled along the street-car track and the finished pavement would be thoroughly wet; this was not only done as a matter of good workmanship to aid in curing the cement but to also settle the dust which naturally would rise from the sand being used as a protection to the pavement. This protection sand was allowed to remain on for about a week and was then removed, but the sprinkling was kept up indefinitely, to lay the dust. The pavement was kept closed for from 10 to 12 days before being opened for traffic. This was not as long a time as we would have liked, but due to the large amount of travel during the summer months, we were forced to open after that length of time.

The construction is what is called the semi-monolithic

style, for which it is claimed that the cement-sand cushion forms a bond between the concrete base and the brick. Theoretically this appears to be all right, and as this was the first of this style of construction with which the writer had had anything to do, he naturally watched the results with interest, particular attention being paid to whether or not the cushion was setting not only to the base but to the brick, as claimed. Examinations showed that while the cushion was setting, it was not adhering to either the base or the brick. This led us to consider the reasons why. We always found that the top of the cushion would not set as hard as the bottom. The cushion is mixed dry, the particles of cement being simply mixed throughout the sand, but in no way a part of the sand. Water applied to moisten the cushion soaks from top to bottom. This action separates the cement in the top of the cushion from the sand and carries it to the bottom. It also has the effect of washing or cleaning the sand.

In mixing concrete the object is to coat every particle of gravel and sand with cement mortar. When each particle is coated and covered with the mortar, it naturally adheres. This action, however, does not occur in the cement-sand cushion. Instead of all of the particles being coated with cement mortar the opposite takes place, the water cleaning the sand rather than coating it. This led the writer to try the following form of sand cushion, which was adopted as a vast improvement over the one just described:

CUSHION MOISTENED WITH GROUT

The cushion was mixed dry, placed on the street and shaped with a template. Instead of clean water, cement grout thin enough to flow from a sprinkling can was applied to the cushion, thoroughly wetting the top. The brick were then laid upon this cushion and rolled. A very much smaller amount of water was then applied to the brick than formerly—in fact only enough to wet the brick so that they would not absorb the cement grout. Then the brick were culled and brick taken out at various places for inspection. It was found without exception that the cement-sand cushion always clung to the bottom of the brick, thus proving that there was a complete bond, something which we never found until we applied the cement wash to the cushion.

The writer feels satisfied that this is a big step in the construction of brick pavements of the semi-monolithic type. He believes further that it would be a good thing if, before applying or laying the cement-sand cushion upon the concrete base, a thin cement grout were sprinkled over the base, thus causing the cement-sand cushion to adhere to the base as well as to the brick. The writer believes this will equal the monolithic type of construction and will be far better in view of the fact that it permits continuous work without waiting for the base to get its initial set. It also permits walking over the top of the brick and is much better for rolling, as there is no danger of getting an uneven surface due to the concrete not being set, as is the case in the monolithic construction.

The total cost of the work done was \$14,089.87, from which should be deducted \$291.50 paid by the gas company, leaving the cost to the borough \$13,798.37. From this item \$1,000 should be deducted for old brick sold from the street, leaving a total net cost to the

borough of \$12,798.37. A total of 7875 sq. yd. of paving was laid, giving a unit cost of \$1.75 per square yard. This includes removing old brick, removing and hauling away old cushion, laying the concrete base, cement-sand cushion, grout filler, etc., and is made up as follows:

COST PER SQUARE YARD	
Cement-sand cushion, laying brick and grout filler	\$0.275
4-in. concrete base	.140
Brick hauling	.165
Brick	6.20
Removing old cushion, tearing up brick and hauling away, etc.	.290
Expansion joint, testing brick, water, lumber and tools	.060
Total per square yard	\$1.79
Deduct 4 cents for concrete laid for the gas company, leaving net cost to borough, \$1.75 per square yard.	

While we were doing this work, the borough had let contracts to the amount of \$35,000 for the paving of various other streets. The bid by the lowest responsible contractor to do this work was as follows: 5 in. concrete base, ordinary sand cushion, 3 in. brick and sand filler, \$2.12 per square yard. This does not include any excavation, and compared with our cost of \$1.75 per square yard shows a saving of 37 cents per square yard, or that we have made a total saving of about \$3,000. The difference of 1 in. in the concrete base as laid by us and as bid by the contractor was more than made up by the fact that his bid covered an ordinary sand cushion and sand filler while we laid a cement-sand cushion and a grout filler. We have also made an additional saving of about \$300 in inspector's fees, as it was necessary for us to retain an inspector on our own work.

The street is about 4500 ft. long, and some parts have been laid and traveled over for about four months, and all of it for over two months. Its appearance is excellent, and the quality of work seems to be all that could be desired.

Water for Canal Lockages

From a study made of the water supply for the Panama Canal it was ascertained that an average of 7.21 million cubic feet of water was used for each through lockage from ocean to ocean; that an average of 12,787.47 million cubic feet of water was wasted over Gatun spillway, or a sufficient quantity of water to make 1773 through lockages each month. Based on 30-day operation this would mean 59 lockages per day over and above the average traffic for the past year. According to the latest annual report of the governor of the Panama Canal, the maximum number of lockages which can be made in 24 hours is 48, assuming that one vessel leaves the upper flight at Gatun just as another enters the lower chamber, and vice versa, both chambers being used.

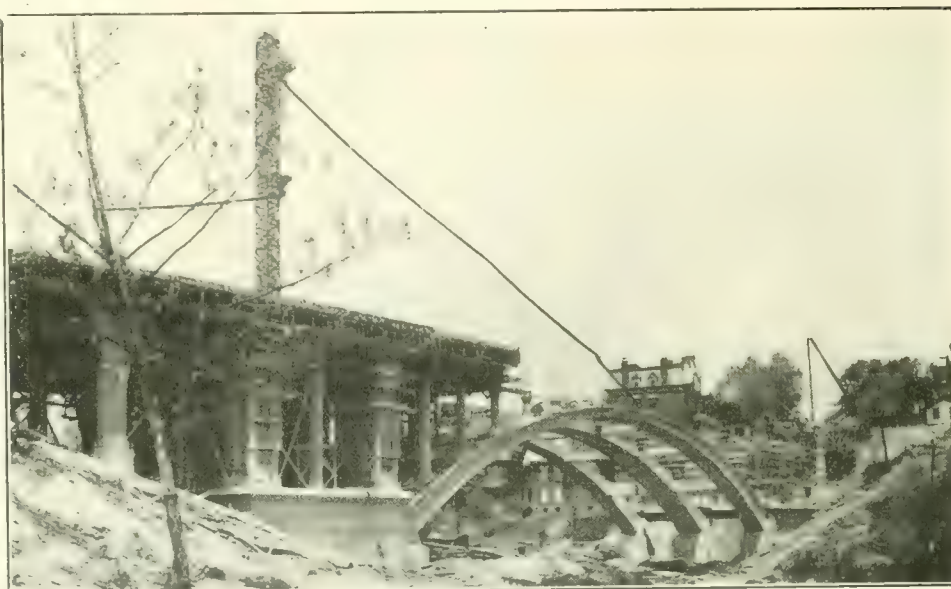
Appearance Governs Design of Park Avenue Bridge, Cincinnati

Massive Abutments of Cellular Type Support Heavy Piers—Curved Outlines Adopted for Beams and Brackets

By J. R. BIEDINGER

Assistant Engineer, Engineering Department, City of Cincinnati

REPLACING an old wrought-iron bridge which had become inadequate for modern traffic, the new reinforced-concrete bridge which carries Park Avenue, Cincinnati, over the Kemper Lane ravine into Eden Park exemplifies the modern tendency toward suitable architectural treatment. Among the special features designed to improve the appearance of the structure are the use of curved or arched outlines for stringers,



ARCH RIBS COMPLETED AND FORMS REMOVED—NOTE MASSIVE APPEARANCE OF ABUTMENTS

floorbeams and sidewalk brackets, molded capitals and bases for the spandrel columns, ogee moldings for the main outside ribs, and unity in the treatment of the approach spans, heavy cellular abutments and the piers above them. The design of these massive cellular abutments also contains elements of unusual interest in the use of inclosing slabs and molded copings.

LOCATION AND GENERAL DIMENSIONS

The Park Avenue Bridge, located symmetrically over the Kemper Lane ravine, and carrying Park Avenue into Eden Park, consists of a single main arch span 180 ft. long, with massive abutments, above which are heavy piers to carry the roadway, with arched stringers similar to the arched approach spans on each side. The roadway is 40 ft. clear width. Two sidewalks, 12 ft. 6 in. wide, are carried by cantilever cross-beams with curved outlines.

The three main arch ribs are rectangular in section, the two outside ribs are 6 ft. 9 in. wide and the center rib 10 ft. wide—all varying in depth from 3 ft. at the crown to 6 ft. at the springing lines. The span is 180 ft. and the rise 31 ft. for the center line of the arch ribs. The reinforcement consists of longitudinal rods



CURVING OUTLINES, MOLDINGS AND COLUMN CAPITALS, MASSIVE PIERS AND ABUTMENTS IMPROVE ARCHITECTURAL EFFECT

amounting to 1 per cent of the crown section divided equally between the upper and lower sides. This longitudinal steel is well tied together with special $\frac{5}{8}$ -in. bolts between plates to form U-bars. Where splices occur special clips are used.

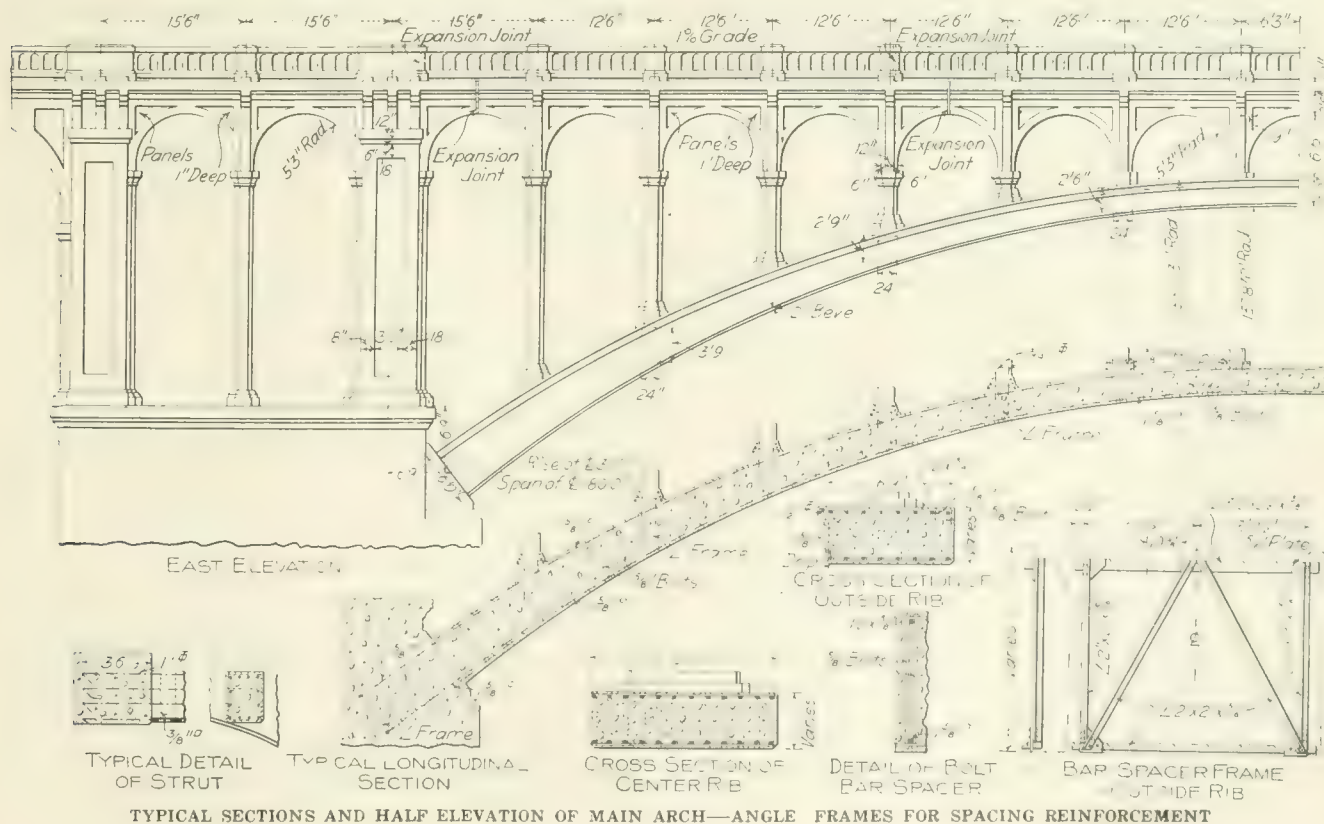
In order to insure accurate spacing of the longitudinal steel, which is quite heavy, special spacer frames, as illustrated in one of the drawings, were adopted.

ARCHITECTURAL FEATURES

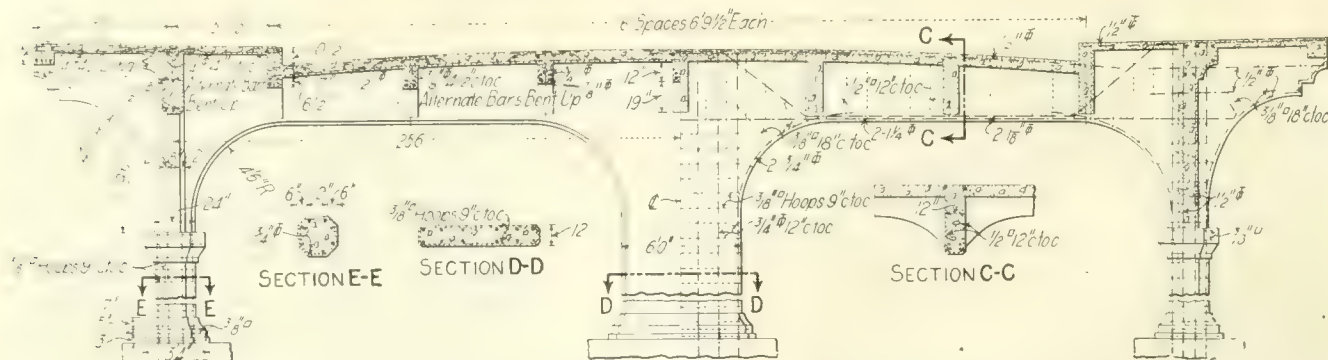
As the structure is in line with one of the proposed boulevards of the city, as well as in Eden Park, particular care was taken with the architectural treatment. The course of Kemper Lane is changed to make it pass under the center of the arch, and the sides of the ravine are graded to approximately the same slopes. Throughout the entire structure sharp corners and angles are

eliminated as much as possible. Curved cantilever brackets carry the sidewalks and the posts of the open railings. Arch outlines are used for stringers and cross-beams, and paneled spandrel arches spring from molded capitals above the spandrel columns. These spandrel columns rest on molded bases on the arch ribs. The outside main ribs have large ogee moldings on the top outside corners.

Prominent skewbacks are seen in the massive-appearing abutments, which are also finished by ogee copings similar to those on the arch ribs. The architectural treatment of the approach spans and the retaining walls is made to harmonize with that of the main span. All panels and flat surfaces of the entire structure are bush-hammered. From the northeasterly corner of the bridge a concrete stairway follows the slope down to Kemper Lane.



TYPICAL SECTIONS AND HALF ELEVATION OF MAIN ARCH—ANGLE FRAMES FOR SPACING REINFORCEMENT

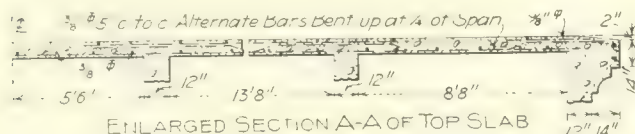


CROSS-SECTION OF FLOOR ABOVE ARCH RIBS—ARCHED OUTLINES ARE USED FOR GIRDERS

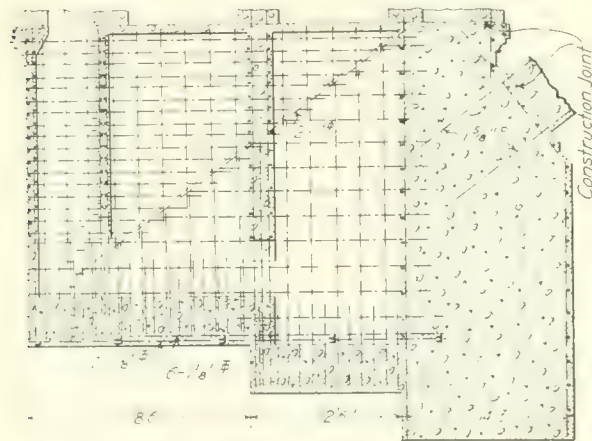
Tongue-and-groove expansion joints allow longitudinal movement of the deck, the 1-in. vertical spaces of the joints are filled with tarred felt and the horizontal joints are formed by a thin layer of tar paper separating the concrete surfaces. The floor adjacent to expansion joints is supported by cantilever beams. Rectangular struts, as shown in the sectional drawing, are pro-

vided about every 25 ft. between the main ribs, to give lateral stiffness.

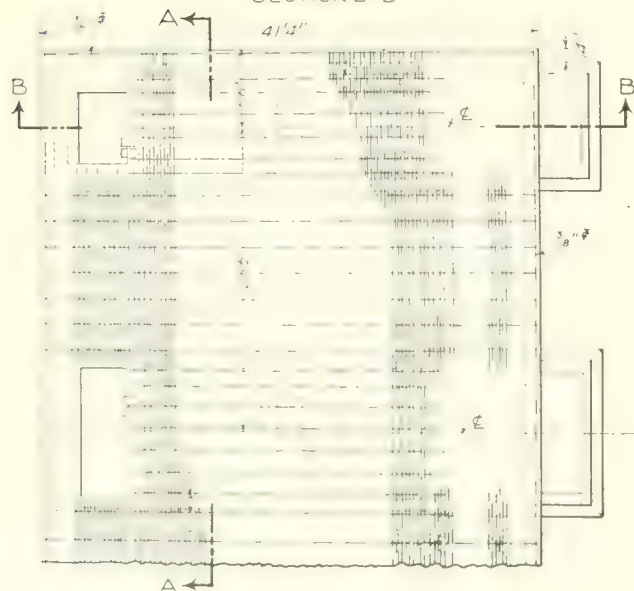
The spandrel arches and also the approach arches were designed as beams and not as true arches. The cross-beams were designed as continuous beams over three supports, the overhang of the sidewalk brackets being considered as part of the beams in the design.



ENLARGED SECTION A-A OF TOP SLAB



SECTION B-B



HALF PLAN OF TOP

CELLULAR TYPE OF ABUTMENT—NORTH ABUTMENT SHOWN

LIVE LOADS AND ALLOWABLE STRESSES

The live loads used in the design are as follows: Roadway slabs, 600 lb. per square foot; sidewalk slabs, 100 lb. per square foot; cross-beams and stringers, 20-ton road roller with 20 per cent impact or 150 lb. per square foot on the roadway; arch ribs, 100 lb. per square foot over the entire bridge. A temperature variation of 60 deg. Fahr. was used in the design of the arch ribs.

The allowable stresses were: Tension in steel reinforcement, 18,000 lb. per square inch, except in the abutments, where 20,000 lb. was permitted; compression in concrete, 650 lb. per square inch in slabs and beams, and 700 lb. in the abutments. In the arch ribs a maximum compressive unit stress of 650 lb. was allowed on the equivalent section (n taken as 20) for dead and live load stresses and 800 lb. for the sum of all stresses, including temperature and rib shortening. As all beams are liberally provided with shear bars, a maximum value of 150 lb. per square inch was allowed in shear.

On clay foundations the maximum soil pressure allowed was 4000 lb. per square foot; and on rock, 10,000 lb. per square foot.

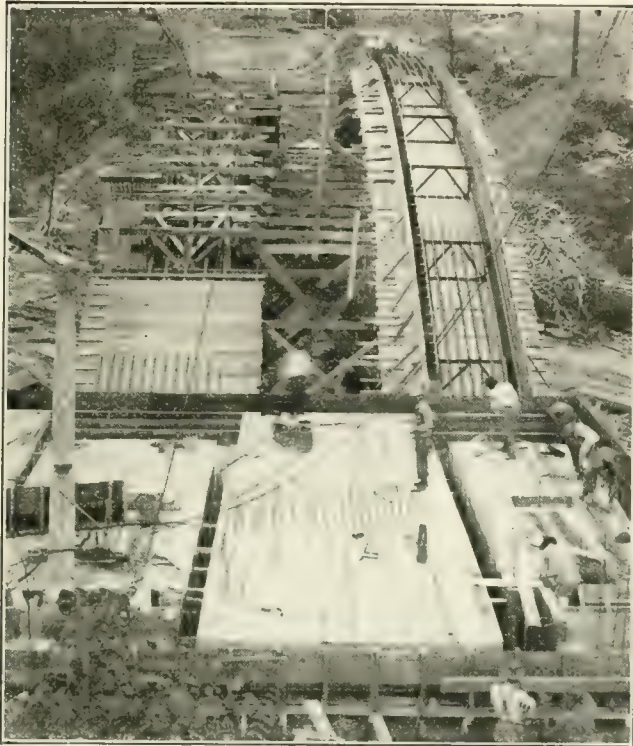
CELLULAR ABUTMENTS

The massive appearance of the main arch abutments was attained economically by using a cellular design, as indicated by one of the drawings. For each main arch rib there are two abutment ribs with sloping top surfaces, well reinforced with steel and tied into the stepped footing slabs with shear bars to insure ample strength. The footing slabs are stepped to give an added factor of safety against sliding on the foundations. The curtain walls on all four sides and the top slab, all reinforced with steel, inclose the abutments and give the appearance of solid blocks of concrete. Drainage pipes connected to a nearby sewer are placed in the floor of each abutment to prevent the accumulation of seepage water.

The retaining walls are mainly of the buttressed type. As filled ground was encountered under some portion of these walls, it was found necessary to place sup-

porting walls carried to rock under the buttresses. The footings for these walls were so designed that the foundations receive practically uniform pressure.

The structure was designed by the writer under the direction of the Engineering Department of Cincinnati, of which Frank S. Krug is chief engineer and Frank L. Raschig, principal assistant engineer of the



FORMS IN PLACE FOR CELLULAR ABUTMENT AND OUTSIDE RIB

Department of Structures. The construction was supervised by Paul Laur, assistant engineer of construction, and R. J. Coffin, resident engineer. D. P. Foley is the contractor for the work.

Advantages of Fixed Set-Back Lines

Two chief advantages of establishing set-back lines have been pointed out by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, in a report to the Committee on City Plan. One is the protection of those who have bought and improved their property, particularly in residential districts, under restrictive covenants, which later expire and thus expose the property owner to loss and depreciation when adjacent lots are improved by buildings flush with the property line. The other advantage is in the possibility of laying out streets of less width between street lines, which would yet serve the local traffic for many years. If more roadway capacity were then needed, part of the space between the street lines and the set-back lines could be added to the street. Thus a street could be paved at a smaller initial cost to the owners and the city would save the cost of maintaining an unnecessarily large area of pavement. This fixing of building lines back of the street lines should be done as part of the city plan, and would be limited to sections still undeveloped, or those of a distinctive character which it is desired to preserve.

Michigan Puts Selection of Road Types on Business Basis

Road-Mile Method of Valuation Followed —
Diagram Prepared to Show Relative Costs
Per Vehicle-Mile for Different Surfaces

By D. A. THOMAS

Michigan State Highway Department

THE Michigan State Highway Department, in common with similar organizations in other states, has made a study of the selection of road types, and has reduced to tangible form a few principles which, together with a knowledge of the capacity of different roads for service gained from experience, are useful in aiding county and township officials to choose the proper road to build. It is not believed that the problem of selection has been reduced to a finality. A few ideas are presented here, however, in the hope that they may be of some value to others and may promote the further study of the road situation necessary to produce roads which are above criticism and worthy of rank as engineering achievements and to reduce the present enormous waste of money available for highway purposes, in so far as it is possible to do this by proper selection.

ROAD MUST SATISFY USERS

It is highly important that a road be satisfactory to a majority of its users; no road can otherwise be called good. If a road is built which is unsuited to the needs of the traffic or which is not maintained in a manner which will enable it to meet the demands made upon it, the people of a community often become prejudiced against all roads of the same type and frequently give preference to high-cost roads in locations where low-cost roads would suffice. This difficulty can largely be corrected by the selection of road surfaces which are calculated to meet the demands of the traffic.

Gravel roads, for example, are popular in Michigan, and have demonstrated their ability to stand up under the average country road traffic, which is largely automobile, but less than 400 vehicles per day. They constitute 3000 miles, or 60 per cent of the total improved road mileage in the state to-day. In perhaps 85 per cent of the cases they are rendering satisfactory and efficient service. This figure could be bettered if all roads received uniformly good maintenance. The popularity of gravel roads, however, frequently leads local authorities to decide to construct them under conditions where they are certain to prove unsatisfactory and expensive.

SELECTION OF SUITABLE TYPE OF ROAD REAL PROBLEM

To select a road that is within the ability of the county to pay for is the real problem in many instances. Any type of road will prove expensive for only a few vehicles per day. It is desirable to study the local road-building materials from every standpoint, and to make the selection only after careful investigation. When in doubt, the cost and success of different types under similar conditions in other locations are good criterions to follow.

Some concessions on the part of the user are often necessary. The sensible person fits his expenditures to his circumstances, and the same is true of communities.

Yet frequently we hear complaints because a county is not intersected everywhere with roads as smooth as a billiard table. As a matter of fact, Lake County, Michigan, one of the poorer counties of the state, is showing good judgment in restricting its road building to gravel roads costing \$2,000 a mile. The county is not able to build roads costing \$16,000 a mile as Wayne County is doing, and such expensive roads are not needed.

Most estimates of a county's financial ability to build roads are based on the annual tax receipts, which are in proportion to the assessed valuation. This is not the most logical basis for sound judgment. A better measure is obtained by dividing the assessed valuation of a county by the road mileage within its borders, giving the valuation per road-mile. It is not assumed that it will be necessary to build all the roads in a county, but the roads needing improvement will be in direct proportion to the total. Thus, of a number of counties under comparison that one should best be able to improve its roads which has the greatest valuation per road-mile, although all may have somewhat the same assessed valuation.

VALUATION BY ROAD-MILE METHOD

Lake County, which is rated at \$3,980 per road-mile, is lowest in the point of road valuation. Thus it would take all the money that the county is assessed for to improve its roads at \$4,000 per mile. At the other extreme is Wayne County, with a valuation of \$609,000 per road-mile, which is 150 times as large as the road-mile valuation in Lake County. Under these conditions Wayne County is about nineteen times as able to build concrete roads at \$16,000 per mile as Lake County is to build gravel roads at \$2,000 per mile. Oakland County, adjoining Wayne County, has a valuation of \$36,300 per road-mile. It has built, among others, several miles of concrete roads at \$14,000 a mile, thereby stressing itself to about the same extent as Lake County.

The desired end is of course to recommend, where they are needed, roads which will stress the counties to somewhat the same extent. Wayne County can undertake any improvements within reason. Oakland County can afford to build the heaviest-traveled roads of concrete or brick where this type is necessary to take care of the travel, but from an economical standpoint cannot afford to build the lesser-traveled roads of these materials.

BARRY COUNTY ROADS AVERAGE \$4,000 PER MILE

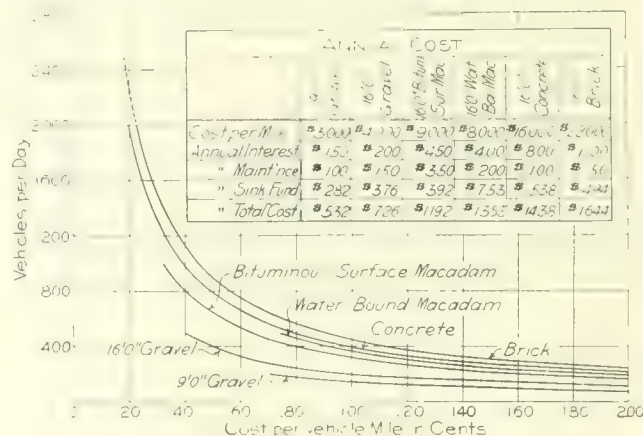
Barry County, on the other hand, in the center of a rich agricultural district and adjoining Kent County, in which Grand Rapids is located, has a valuation per road-mile of only \$16,950. So far its roads are built of gravel at an average cost of \$4,000 per mile. It is conceivable, however, that this county may require roads of a higher class in the future. It is apparent at once that \$16,000 concrete roads would burden the county, but it could afford to build bituminous-surfaced macadam roads at \$9,000 per mile in about the same ratio of cost to valuation per road-mile as Lake and Oakland counties.

Such a schedule as is proposed is subject to various modifications. As a matter of fact 9-ft. gravel roads, such as Lake County is building, cost on the average throughout the state \$3,000 per mile. A selection can-

not be made without a knowledge of local conditions, and the fact that a county possesses a low valuation per road-mile would not outlaw a certain type where the traffic actually demanded it. Finally, since a system of state-aid is in force in Michigan, and as the first cost is not the true cost of a road, the construction costs used as the basis of comparison do not represent the actual cost to the county. Notwithstanding this, the principles here stated are valuable in determining the extent to which it is wise for a county to go in building roads.

HOW ROAD FUNDS ARE WASTED

Again, a road may be entirely satisfactory to its users, entirely within the ability of a county to pay for, but uneconomical. Such is usually the case where a high-cost road is built for a few vehicles per day. Perhaps in no other field where engineering knowledge is essential is there such a lack of the application of scientific principles as in the selection of road types. This is due to the fact that a large share of the money spent on roads is paid out by men who do not know what is needed. If a business man made the mistakes



COST PER VEHICLE-MILE FOR ROADS OF DIFFERENT TYPES

that are made in highway construction he would be bankrupt inside of a year. Fortunately it is not possible to bankrupt the taxpayers. From an engineering standpoint, however, it is the duty of those in charge to spend the money in a scientific and economical manner.

In a system so large as to serve a whole state, nearly every type of road has its place, and the same is true of many counties. It is a familiar fact that in general the traffic over a road decreases as the distance from cities and towns becomes greater. It is the experience in Michigan that even on trunk lines the local traffic amounts to about 85 per cent of the total. Yet there are those who would build nothing but high class, hard-surfaced roads everywhere without stopping to consider that to do so may sometimes be as ridiculous as to put on a dress suit to feed the cows.

A careful study of traffic conditions and a count of the number and kind of vehicles passing over the road daily are of prime importance. In localities which are financially able to carry out any improvements within reason the traffic is the logical basis on which to select a road. After making the necessary allowance for future increase, that type should be selected which ex-

perience has shown can be made to carry the traffic imposed upon it for the least annual cost, taking into account interest on the first cost, maintenance, and a sinking fund which will renew the surface when it wears out or will retire the bonds if built by bond issue. If analyzed, this type will usually show the least cost per vehicle-mile.

WHAT ROADS REALLY COST

A table showing the annual cost and curves for the cost per vehicle-mile of several different types of roads have been prepared and are reproduced herewith. The construction and maintenance costs represent average values from the experience of the Michigan State Highway Department during the past two years, with small amounts added to provide for future betterments. Money is taken as worth 5 per cent. The sinking fund earns 3 per cent, and since most of the roads of Michigan are built with money derived from direct taxation rather than from bond issues it is assumed that the funds will be used for rebuilding or resurfacing as follows: Gravel and waterbound macadam roads resurfaced at the end of 5 years for one-half the original cost; bituminous macadam resurfaced at the end of 10 years for one-half the original cost; concrete resurfaced with bituminous concrete or otherwise rebuilt at the end of 15 years at a cost of \$10,000 per mile; brick rebuilt at the end of 25 years at a cost of \$18,000 per mile.

The curves for the cost per vehicle-mile are discontinued at the points shown because experience has proved that in general the type would not be satisfactory beyond the traffic limits shown. Thus the limit of a 9-ft. gravel road is 200 vehicles per day, that of a 16-ft. gravel road, 500 vehicles per day, etc. In case a road should be constructed or is serving for a greater number of vehicles per day than the limits given, the maintenance would probably cost more than the values assumed. As the upper limit for concrete and brick is approached a 16-ft. road would scarcely be able to care for the traffic, and it might be wise to build an 18-ft. road at a slightly greater cost. Hence the upper portion of the curve for brick is dotted.

CURVES AID SELECTION OF ROAD TYPES

A number of interesting conclusions are apparent from a study of the curves. With the exception of concrete and brick, which cost nearly the same per vehicle-mile because of the probable longer life and lower maintenance cost of the latter, a type of road may be selected which may be expected to serve for an appreciably lower cost than others within certain limits. Concrete, for example, should be able to carry the maximum of heavy travel in Michigan, say 2000 vehicles per day, at 0.20 cent per vehicle-mile. But if it were built for 200 vehicles per day, the cost to the county would be 2 cents for every vehicle that passed over the road. Evidently a 16-ft. gravel road which would carry this traffic for one-half the cost would be far more economical.

It is almost an established fact that untreated water-bound macadam will not stand up any better than gravel under a traffic that is composed largely of automobiles, and, as the curve shows, it is much more expensive. When constructed and maintained with a bituminous

carpet, however, the life and the traffic limit are raised, and the cost is lowered. Thus treated, macadam forms an excellent intermediary between gravel and the higher types.

It will be noted that when the traffic is near 200 vehicles per day, the cost of a 16-ft. gravel road is about 0.30 cent higher than that of a 9-ft. gravel road, but the necessity of providing for future increase would make it advisable to construct the former. Similarly, when the traffic is too heavy for gravel and it is necessary to construct surface treated macadam or concrete—the latter being more often built, since the former has not yet attained a wide use in the state—there is a great increase in the cost per vehicle-mile. It is desired of course to reduce this variation and keep the cost as low as possible.

COSTS COMPARED

Reference to the curves show that for the practical limit of a 16-ft. gravel road, 500 vehicles per day, the cost per vehicle-mile is 0.40 cent, and that on a bituminous-surfaced macadam for 800 vehicles per day the cost is the same. The difference between the total annual costs given in the table is \$466. Theoretically, therefore, if the traffic does not exceed 800 vehicles per day we could afford to spend \$466 plus \$150 (the assumed maintenance for the gravel road below 500 vehicles per day), or about \$600 per mile per year in the maintenance of the gravel road before it would be economical to build bituminous-surfaced macadam, provided that for that sum the road could be kept in a satisfactory condition. Practically, however, a gravel road carrying 800 vehicles per day would be in a continual state of repair and decidedly unsatisfactory.

Depending on local conditions entirely, the gap between a gravel and a higher-class road may be bridged to a certain extent by paying more for the maintenance. When a county is financially able to build a better road for traffic in excess of 500 vehicles per day it should do so by all means. Without doubt future increase will in time make the road economically suited to the traffic passing over it.

Panama Chain Fenders Tested

On Sept. 4, 1915, the S.S. Luz Blanca, navigating the Panama Canal, approached the lower end of Miraflores locks while the chain fender was up and the semaphore in the danger position. The vessel, according to Major-Gen. Goethals' latest annual report, struck the fender and without appreciably stopping its headway broke the chain. The fact that the machine had been blocked made it impossible for the fender to operate. Nevertheless, the apparent ease with which the vessel went through the chain called attention to the desirability of a working test to determine the effectiveness of the fenders, and a committee was appointed to make a series of experiments upon one of the chain-fender machines at Gatun. Considerable data were obtained, and the results of the tests indicated that the chain-fender machines will operate satisfactorily when properly adjusted and that no difficulty would be encountered in stopping any vessel approaching the locks at a speed under 2 miles per hour. Some minor modifications were made in the apparatus.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Canvas-Covered Timber Coffers Lets Contractor Out Cheaply

THE HIGH COST of steel sheet piling led the contractors for a 150-ft. highway drawbridge over the Obion River near Dyersburg, Tenn., to use Wakefield piles covered with tarpaulin for the 18-ft. circular center-pier cofferdam, thereby saving \$1,500. The piles were made from 2 x 10-in. planks 22 ft. long, driven about 7½ ft. below the bottom of the pier. The bearing piles, 35 ft. long, were driven on 3-ft. centers, after the Wakefield piling had been driven and an orange-peel bucket had excavated the caisson 6 ft. below the bed of the river and 13½ ft. below the normal water level.

After the work was under way the county officials, who constituted the inspectors, but were not engineers, insisted on having the caisson pumped dry to see the character of the foundation before concrete was placed on the bearing piles. To accomplish this cheaply the contractor sewed together two strips of tarpaulin 5 ft. wide and 70 ft. long, making a width of 10 ft. The canvas was given two coats of oil and then wrapped on the outside of the piling, leaving about 2 ft. to lay horizontal on the river bed. This lap was weighted down with excavation, making a sufficiently tight seal to permit unwatering the caisson quickly. The total cost of the tarpaulin was \$52.

The work was carried out by the Vincennes Bridge Company, for which O. Bundy acted as constructing engineer.

Pull Long Piles Down Through Roof to Strengthen Wharf

ALONG the San Francisco waterfront wherever it is necessary to drive piles in a wharf with a shed already upon it a construction scheme has been developed which permits of rapid progress. The piles are lowered through the roof as far as they will go of their own weight, after which they are pulled down by a cable wound on the drum of a small pile driver operating on the floor of the wharf and with leads short enough to pass under the roof truss. When the head of the pile is down to within a few feet of floor level the driver is moved up over the pile and the hammer completes the driving, a follower being used to get it down to a level at which it can be crowded under the cap.

In repairing wharves which require additional piles, the location of each pile is first determined and marked upon the roof. Holes are then cut in the roof, usually about 3 ft. square, as near these locations as roof

trusses will permit, or, for a width of 2 or 3 ft., roofing and sheeting may be removed for the full span between two trussed rafters. The piles are rafted to a convenient location alongside the wharf and are picked up by a floating derrick and lowered through the holes in the roof, care being taken to have them enter the mud on such a batter that they can be easily sprung into place under the cap when driven to the proper depth.

On the work shown in the illustrations, the length of piles used was between 60 and 65 ft. The depth of the water was about 20 ft., and the piles usually sank of their own weight until only 15 to 20 ft. remained projecting above the roof. Thus the piles were "driven" for a depth of about 35 ft. by the use of the cable from the winding drum of the driver.

The tackle for pulling down the piles was a snatch block secured to the cap, through which ran the cable from the sheave at the head of the driver leads to another block attached to a short length of cable wrapped around the head of the pile by a helper on the roof. The mud bottom along portions of the San Francisco waterfront is so soft that there is no difficulty in pulling these piles down almost to floor level with the ordinary small driver engine with 8 x 10-in. cylinders.

Just before putting the follower on the pile for final driving, the head is beveled slightly with an adz on the side next to the cap. When the follower has driven it to

ONCE there was a man who reasoned that if he didn't give anything away, he'd be rich from what he saved.

BUT everybody got on to him. He didn't get anything.

AND there was another fellow who figured he didn't have anything to give.

BUT others had a better sense of values. They stole from him and he didn't even get credit.

HERE'S THE POINT: If we publish your ideas in the Hints for the Contractor section, you'll get pay for them—and credit, too.



BOOM STEPPED IN LEADS PASSES PILES THROUGH ROOF TO SMALL DRIVER UNDER PIERSHED



INSIDE SHED, SMALL DRIVER PULLS PILES DOWN WITHIN REACH OF HAMMER

the proper level the pile usually tends, assisted by the bevel, to spring under the cap. The tightness of the joint can be controlled to a nicety by the amount of bevel and the exact depth to which the pile is driven. The custom is usually to force the new pile under the cap with a fit so tight that the cap will be raised about $\frac{1}{8}$ in., or enough to take a considerable portion of the strain on the new pile. When the pile is ready to be sprung under the cap the line from the driver is passed around it and around the far side of the cap, so that tightening up the line forces the new pile into place. Finally, a drift bolt is driven through the cap and into the pile to hold it in place.

One of the pile drivers built by the harbor commission is used as a derrick in this work, a 96-ft. pile boom being stepped between the leads. The large end of the pile is butted against timbers about 24 ft. above the deck of the barge. The pile is then raised and lowered as a derrick boom by a line to its smaller end passing over the sheave at the head of the leads. Of course this rig does not permit of swinging the boom, but as the barge itself can be quickly turned by shore lines, the same result is accomplished, and the crew can pick up the floating piles and drop them through the holes in the roof.

The work on the San Francisco harbor front is under the direction of the Board of State Harbor Commissioners, of which Frank G. White is chief engineer.

Four Men Hoist Forms for Large Building with Hinged Traveler on Casters

ONE OF THE TRAVELERS shown in the illustration, operated with a hand crab by four men, handled all the forms from each floor level to the next for each unit on the large reinforced-concrete building in Hoboken, N. J., the construction of which is described on page 171 of this issue.

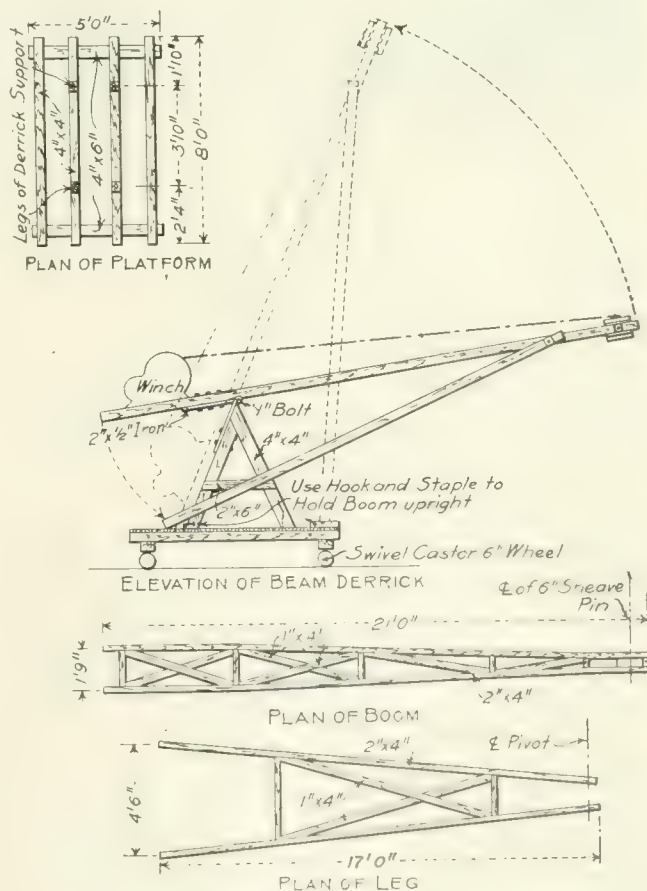
The traveler, as shown in the accompanying sketch, consisted of a framed boom of light timbers hinged

near its lower end on a long bolt passing through the top of a low frame built on a square timber platform mounted on four large casters. The crab was set on the lower end of this boom at such a distance below the hinge as to balance the boom almost perfectly. The boom was held in position when raised by two planks, hinged to it near its upper end, and footed on the forward corners of the platform.

In use, the rig would be set in an elevator shaft or at the edge of a completed section of the floor above. As the forms were stripped, the panels would be carried short distances and piled under the end of the boom.

Two men hooked them on to these piles as they were made and hoisted them to the level above, where two other men landed them. It frequently happened that before all the forms were stripped which it was desirable to hoist at a given point, the work had progressed until the traveler was standing, surrounded by concreted formwork, in a hole temporarily left in the floor above. It was for this reason that the boom was hinged. This only made it necessary to leave a sufficient opening in the forms of the upper floor to permit swinging the boom down to a horizontal position. The traveler could then be rolled along the floor below by the two men at that level to the next point where it was wanted.

The device was used by the contractors for the building mentioned, the Turner Construction Company, for whom the work was carried out by Albert Larsen, superintendent.



BOOM OF LIGHT TRAVELER FOR HOISTING FORMS RAISED AND LOWERED THROUGH HOLES IN FLOOR ABOVE

Concrete Lining of Channel Bed Flooded to Protect It from Freezing

By ALBERT S. FRY
Memphis, Tenn.

THE PHOTOGRAPH shows conditions which made it easy for the Koehler Brothers-Fowler Construction Company, of Memphis, to protect from frost concrete laid in the floor of a drainage channel in that city by flooding it at night with water. The slab shown, which had set long enough not to be injured by flooding it, is part of the curved-slab lining placed in the bottom of Gayoso Bayou. At the time it was placed the tem-



CURVED CONCRETE SLAB, LAID ON BOTTOM OF CHANNEL, PROTECTED BY FLOODING DURING SEVERE COLD SNAP

perature was above freezing during the day time but fell at night to 10 deg. above zero. The waters of the Bayou were diverted around this part of the work, and water was kept out of the section being concreted by a low earth barrier at its end. When it was known that the temperature would drop to a low point during the night, it was a simple matter to cut the earth barrier, open up the dam which diverted the Bayou and flood the concrete to a sufficient depth to protect it.

The work is part of the project being carried out by the city of Memphis to afford protection against Mississippi River overflows.

Old Touring Car, Rigged to Haul Trailer on Road Contract, Does Work of Four Teams

By J. C. BENTLEY
Engineer and Contractor, Elizabeth, N. J.

THE TRACTOR and trailer illustrated herewith was used on the concrete-road job in Lakewood, N. J., described on page 184. It consisted of a 1910 Thomas touring car with a 40-hp. motor and a 2-yd. Eagle dump wagon.

The touring car was remodeled as follows: Four-inch solid tires replaced pneumatic tires upon rear

wheels; two additional leaves were added to each rear spring; gears upon the jack shaft were reduced and a fifth wheel was placed upon the chassis over the rear axle. This originally was the entire cradle from the front axle of the dump wagon, but was later replaced by a small cast-iron rocker, which the kingpin of the dumper engaged. With this arrangement there was more flexibility between the two units. The trailer was the standard 2-yd. dumper, and compression cups were installed on the hub of the wheels to insure proper lubrication.

Stone, sand, cement and excavated material were hauled by this unit. The average load was 5000 lb., but

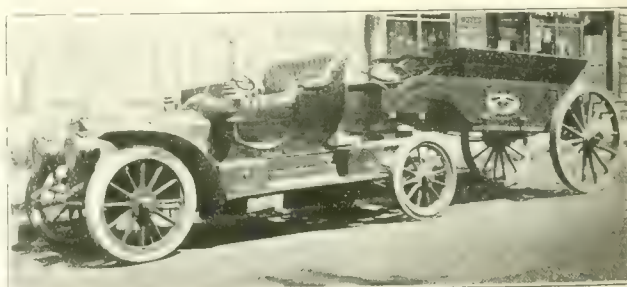
when hauling cement, 70 to 75 bags, or 7000 bbl., was frequently hauled. The total dead weight of the outfit was 5300 lb. Of this the front axle carried 1900 lb., the rear axle (tractor) 2400 lb., and the trailer axle 1000 lb. When loaded with 7000 lb. the live load was distributed as follows: Front axle, 200 lb.; rear axle, 2000 lb., and trailer axle, 4800 lb.

The operating speed was about 12 miles per hour and the gasoline consumption about 1 gal. every 8 miles. No daily record was kept other than to keep track of the number of loads hauled from time to time. One of these records showed twenty-eight 2-yd. loads of stone hauled and dumped $\frac{1}{2}$ mile from the car-unloading point in four hours. Stone was unloaded through a trestle and only 45 to 60 sec-

onds were required to obtain a load. Teams at the same time made 12 to 14 trips each with $1\frac{1}{2}$ -yd. loads.

On good hard roads this outfit worked very well, doing the work of three and four teams, depending on the haul. Care had to be exercised whenever the full power of the motor was required because of the light rear construction of the tractor. Several parts were broken until the working limit was discovered.

Everything considered, the experiment proved very satisfactory and has convinced the writer that a small-capacity truck with a properly constructed trailer will be of more service on small highway contracts than the larger trucks which he at one time operated.



TOURING CAR CONVERTED INTO TRACTOR

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Foreign Trade Discussed in Pittsburgh

Leading Business Men from Every Section in Attendance

Co-operation was the dominant note of the Fourth National Foreign Trade Convention which met in Pittsburgh last week. It was sounded in every general meeting and every group session. Finally it was crystallized in the report of the National Foreign Trade Council on the Webb Bill, where it was pointed out that the nations of Europe have developed their foreign trade co-operatively and are planning still more extensive and intensive co-operation after the war. The German Government's co-operation with her manufacturers is proverbial. Now England and her colonies are planning an economic alliance, while similar broad plans are in the making as between the Entente Allies, on the one hand, and the Central Powers on the other. Moreover, it is certain that Germany at least, and probably France and England, will arrange to buy co-operatively in the United States after the war is over. Only in the United States are individual companies left to stand alone in the development of foreign trade. This individualistic procedure must give way to co-operation if we are to win and keep such a share of foreign trade as will introduce a shock-absorbing diversity factor into our economic affairs.

Aside from this dominant note of co-operation, the main points emphasized were the dependence of foreign trade on foreign investment, on banking facilities, on a sound shipping policy.

Group Sessions

Of the group sessions—covering foreign credits, co-operation in foreign trade, banking and investment, education for foreign trade, function of the export commission house and the problems of the smaller manufacturer and merchant—the latter, by far, was the most popular. Practically every problem of foreign trade expansion that confronts the smaller manufacturer and merchant when he desires to sell overseas had been covered in advance by a series of questions and answers, available to the convention in pamphlet form. These questions and answers gave the text for the contribution of a great variety and volume of valuable experiences of the manufacturers and merchants present. So keen was the interest that instead of the one session of this group that had been planned, four were necessary to dispose of the questions and problems raised.

Of individual papers, it is possible to take notice of only a few. Willard

S. T. Henry

An Appreciation by E. J. Mehren,
Editor, Engineering Record

S. T. Henry has resigned as second vice-president of the McGraw Publishing Company Inc., and on Feb. 1 became identified with the American International Corporation, New York, as vice-president of a subsidiary organization which will handle the export of contractors' machinery and equipment.



Details regarding the new company will be found elsewhere in this section.

In his comparatively brief career with the McGraw Publishing Company Henry has made remarkable progress. Entering the organization, fresh from college, in August, 1904, as an assistant on the editorial staff of the Engineering Record, he rose rapidly through the positions of western editor, Cleveland advertising representative, and western manager of the paper to the junior vice-presidency of the company. Since his promotion to a general executive position, his duties have pertained to all the properties of the company, including, in addition to the Engineering Record, the *Electrical World*, the *Electric Railway Journal* and *Metallurgical & Chemical Engineering and Electrical Merchandising*.

His rapid rise and his present step to a position of very great responsibility are not only a source of gratification to his many friends, but should

Debate First Tentative Valuations at Washington

First Two Days of Hearing Develop Interesting Problems—Does Not Reach Largest Issues

None of the really big questions were taken up in detail in the first two days of the hearing in Washington this week, beginning Monday, before the Interstate Commerce Commission relative to the tentative valuations of the Atlanta, Birmingham & Atlantic Railway and the Texas Midland Railroad. The impossibility, however, of separating the minor questions from the fundamental principles of valuation was indicated by the numerous digressions to such principles. As had been expected, the carriers disagreed with almost every feature of the reports, while on the other hand the state commissions in some instances thought the Division of Valuation had been too liberal. The attendance was greater than at any of the previous valuation hearings.

Parties to the Proceedings

The proceedings were conducted by the commission—the carriers, the state commissions, the Division of Valuation and any other interested parties in turn expressing their views on various predetermined issues. The chief representatives were W. G. Brantley and Pierce Butler for the Atlanta, Birmingham & Atlantic (referred to as the A. B. & A) and the Texas Midland respectively; Thomas W. Hulme, for the Presidents' Conference Committee, C. B. Aitchison, for the state commissions, and Charles A. Prouty, director of valuation, and P. J. Farrell, for the Division of Valuation. Among the other representatives was one for the four railway brotherhoods.

The issues were based on the A. B. & A. report, that road being much the larger of the two. Twenty issues not involving the taking of testimony were listed, together with twenty-one involving general principles on which testimony should be taken. Ten of the first group were disposed of in the first two days. In many of the issues the Texas Midland took no part.

General Points Raised

Before the taking up of the separate issues several general points were raised. Mr. Hulme urged the commission to realize that the problems of the large roads were not presented by these small roads. Mr. Brantley and Mr. Butler presented similar motions, which were not sustained, that the proceedings be abandoned until complete valuations in proper form had been made. Each gave a long list of particulars. Director Prouty held, however, that

only by presentation and discussion of such tentative valuations could the Division of Valuation know the carriers' objections to its figures.

One point of general practice in which there was sharp disagreement was the extent to which the division had admitted the carriers into its confidence. Mr. Brantley held that it had been done only to a limited extent. Director Prouty mentioned the insistence by the government that the carrier be represented in the field, the making of duplicate notes, and the invitation to the carrier to watch the computations. Only in the fixing of unit prices and the treatment of land had the division decided it could not co-operate. Mr. Brantley insisted, however, that this was co-operation only as to the bare bones of the property.

Clearing and Grubbing

Clearing and grubbing was the first issue. The division had declared that the present-day conditions as to forests of the land adjoining the right-of-way should govern, being the only ones free from speculation. Mr. Brantley held that original historical conditions should be assumed, as the only ones free from speculation, admitting, however, that he would gladly accept the other view if applied as well to built-up districts, where, he said, the principle would demand the purchase and razing of assumed buildings. Director Prouty would not admit the possibility of a correct guess as to the buildings that would be encountered. C. E. Elmquist for the state commissions said that both views as to clearing and grubbing involved assumptions; that in reproduction there would be no clearing or grubbing, and none should be allowed.

Joint Property

On the second issue, property jointly used, Mr. Butler took exception to the division's course. He held that in excluding the Texas Midland's two terminals and 14 miles of its main line in the middle, just because these were not owned by the Texas Midland, the road was rendered incapable of public service. He held that all carrier property used but not owned should appear in reproduction cost, with the facts explained. Director Prouty said reference alone to such property was enough. The division was unwilling, he said, to duplicate the property, and to keep the cost of inventory within reason it was necessary to deal with each carrier's own property when that carrier was under valuation.

What Mr. Brantley called the reverse of this case was brought up by the third issue—telegraph line along the A. B. & A. The latter road claimed to have built this line and to have permitted the Western Union, by a contract, to take over the line and add wires, the A. B. & A. retaining two wires exclusively, however, and having preferential rights over others. No allowance was made in the tentative valuation, however, and the railroad was the loser. This question was deferred pending a statement

from the Western Union regarding the facts of ownership.

Property Owned But Not Used

Another phase of the general question of divided ownership or use was raised by the fourth issue—track leased to the Woodward Iron Company. According to Mr. Brantley, the A. B. & A. had started a 14-mi. line and abandoned it, had (while in receivership) been ordered by the courts to complete it, had operated it two or three years at a loss, owing to stagnation of the territory served, and had then leased it for a nominal rental to the Woodward Iron Company, reserving the right to operate over the entire line, but in fact using only 2 miles. He thought the company ought not to be penalized for having made a bargain eliminating a loss, and thought the court's order to complete the road sufficient answer to Mr. Aitchison's proposal that this be simply classed as an unfortunate venture. The division excluded this from its summary of reproduction cost, while the carrier claimed it. The division's answer was that on the date of valuation it was not in use for common-carrier purposes, the Atlanta Terminal Company, of which the A. B. & A. was lessee, and not the A. B. & A. itself, being owner of the line in question.

Form of Report

The next six issues were discussed in two groups, one having to do with liquid assets—working capital, materials and supplies and current assets—the other with donations to predecessor companies, and deeds upon nominal consideration. Perhaps more important than anything brought out on these points was the general question that repeatedly came up—the form of the tentative valuations, and what they included. Mr. Butler thought that as presented they excluded all the supporting data in the supplementary land, engineering and accounting reports, and following the signature in the main report. On that basis he thought none of the tentative valuation, if made final, would be acceptable as prima facie evidence. Mr. Farrell thought it clear enough that the whole report was to be taken together. The question of the proper form of the report, and whether there shall be an ultimate finding of value, is one, however, in which there is apparently some doubt, both among the representatives of the Division of Valuation and among those of the carriers.

Highway Courses at University of Kentucky February 5 to 10

Short courses in highway engineering will be held Feb. 5 to 10 at the University of Kentucky. During the last three years the attendance at these courses has increased from 50 to more than 200. It is expected that this year's enrolment will exceed past records. The instruction is directed by the highway engineering department of the university, of which Prof. D. V. Terrell has charge.

Foreign Trade Discussed in Pittsburgh

CONTINUED FROM PAGE 201

Straight, vice-president of the American International Corporation, New York, made a strong plea for the adoption of a bargaining tariff. C. K. McIntosh, vice-president of the Bank of California, San Francisco, argued for extensive educational work which would impress upon everybody "from the chief magistrate to the humblest citizen" that individual prosperity is inseparably bound up with foreign trade and general industrial conditions. The subject of foreign loans here during the war period was taken up by Festus J. Wade, president of the Mercantile Trust Company, St. Louis. He declared it his belief that every dollar of obligations contracted here during the war would be paid and that there need be no fear whatsoever of repudiation. If the foreign nations were to repudiate these obligations, trade between those countries and the United States would necessarily stop, a result that would be disastrous to the European nations, particularly under the conditions which will obtain at the close of the war.

Reports Presented

Among the stimulating and valuable reports presented were the following: Industrial reconstruction in Europe, examples of American export enterprise, suggested methods of co-operation in foreign trade, the Webb Bill, world shipping conditions and the American merchant marine; world trade conditions after the European war.

The sentiment of the convention, as a whole, was summed up in the report of the General Convention Committee. As has been customary in the past, no resolutions were presented. The committee merely reported what it considered to be the consensus of the convention, as developed in the papers and discussions.

It pointed out that the development of our foreign trade depends upon our resources, on our enterprise and on the education of a body of young men fitted for the demands of foreign trade and anxious to participate therein. It depends further on the participation of a large number of moderate-sized firms. The government, the report stated, can help in many directions—by making suitable commercial treaties, by collecting from abroad and disseminating here information regarding foreign requirements, by permitting co-operation, etc.—but in the last analysis our success will depend upon the initiative and ability of our merchants.

Should Pass Webb Bill

The greater part of the report, which was, however, brief, was devoted to those matters of a legislative character which now press for solution. The need for the prompt passage of the Webb Bill was again emphasized, while the necessity of a sound shipping policy, of straightening out the treaty situation, which has been turned topsy-turvy

by the war, and of a flexible tariff, was discussed in some detail.

Finally, it was pointed out that many different departments of the government need to co-operate in order that every facility may be offered for foreign-trade expansion. The legislative features have been emphasized above, but the Department of State, the Department of Commerce, the Federal Trade Commission, the Shipping Board, the Federal Reserve Board and the Tariff Commission (soon to be appointed) all have certain functions with a more or less direct bearing on export trade.

New York Central Railroad Plans \$20,000,000 Cutoff

A reduction of two to five days on freight shipments between New York, New England, and the West, together with relief of freight congestion at various points and provision for growth of commerce for many years, is the promised result of the so-called "Castleton cutoff" improvement of the New York Central Railroad. After ten years of planning the road has reached the point of readiness for construction work. Official announcement was made of the plans in an address made this week by H. Leroy Austin of Albany, counsel for the New York Central.

The new cutoff, 20 miles long, will double the freight capacity of the New York Central and nearly double the passenger capacity. The bridge to be thrown across the Hudson two miles south of Castleton, which will cost \$5,000,000, must be completed by 1920. The whole project involves the expenditure of \$20,000,000.

Engineers' Status in Ohio Needs Correcting

Concerted effort on the part of engineers in Ohio to effect a revision of laws which will dignify their professional services so as to make unnecessary a public letting to the lowest and best bidder was called for at the Ohio Engineering Society meeting Feb. 1 by W. J. Sherman.

The status of the engineer practising in Ohio is briefly reviewed as follows: In the opinion of many solicitors he cannot be engaged at a fee in excess of \$500 without a public advertisement and an award to the lowest and best bidder. A lawful contract cannot be entered into for his services unless it is certified that there is money enough in the fund that has not been otherwise appropriated. In many, and perhaps most, instances there is no money in the fund and cannot be until the bonds have been sold. Bonds cannot be sold until plans have been adopted and estimates approved. The services of an engineer are required before the plans and estimates can be submitted, and even though money be in the fund when the service contract is executed, it is likely to be transferred to the general fund at the end of the calendar year.

S. T. Henry

(CONTINUED FROM PAGE 191)

be an inspiration to all the younger readers of the Engineering Record. He came to the McGraw Publishing Company inexperienced in publishing work and unknown to the organization. Yet so well did he perform his appointed tasks that in 10 years he had run the gamut of positions on the Engineering Record and had been graduated to an executive post in one of the great technical publishing organizations of the country. Now, at the age of 35, with a matured judgment, born of the responsibilities he has had to carry, he steps into a still broader field—one in which his influence can, and undoubtedly will, be felt internationally.

Reasons for His Success

Those who know Henry intimately will not need to be told the characteristics that have brought him such singular success. No one can meet him without catching his enthusiasm; no one ever put a difficulty before him without finding a sympathetic response and receiving any assistance which lay in his power. These qualities, combined with exceptional mental alertness, great capacity for work and ability to sense the big possibilities of plans, have made him a marked man in every circle in which he has moved.

Of course—and this is said to the younger men—his success did not come automatically. While endowed with exceptional abilities, he has made effective use of them by doing a prodigious amount of work and by never shunning new responsibilities.

He has always attached great importance to his physical condition—due to his experience as a member of the track team in college. These physical precautions may appear, to the average young man, to be trivialities, but they are the foundation on which Henry's exuberant good health is built, and this good health, in turn, is reflected in his clear-headedness and his enthusiasm. He himself, we have no doubt, would attribute much of his success, indirectly, to be sure, but no less certainly, to his physical vigor.

Outside Relations

The enthusiasm that he has displayed in his business connections has been manifest, too, in his outside relations. No organization to which he ever gave time but profited by his counsel, his vision, and his energy. In the trade and technical publishing field he is as well and favorably known as among the readers and advertisers of the Engineering Record.

Among the alumni of the University of Illinois, his Alma Mater, likewise, his acquaintance is very large. He organized local alumni associations in New York and Cleveland and was instrumental in putting the Chicago association on a better basis. The university, in turn, has shown its appreciation of his ability by repeatedly asking him to lecture before both the

engineering and the general student bodies. He has never failed on these occasions to put into his talks the enthusiasm and optimism that have made his words remembered long after those of older, but less magnetic, participants in the programs were forgotten. His university did much for him and, like a loyal son, he never fails in his duty, when occasion permits, of repaying the debt.

In his new responsibilities he will be able to make good use of the experience gained on the editorial and advertising staffs of the Engineering Record. His function will be to promote the sale abroad of American contracting equipment and machinery—a field that he probably knows better than any man in the country. For 10 years, as editorial and advertising representative of the Engineering Record, he was brought in close contact with the users and the manufacturers of such machinery and equipment, and with his engineering training as a background he acquired an exceptional grasp of the uses and economics of the various types. In addition to acquiring a knowledge of the equipment itself, he built up that broad acquaintance in the field without which singular success in a work of the magnitude of that he is now undertaking would be impossible. He goes to his new position, therefore, exceptionally well prepared for its responsibilities.

The best wishes of his associates in the McGraw Publishing Company and of his host of friends in the engineering and contracting fields go with him in his new work.

Asks Receiver for Everglades Drainage Funds

Misuse of Funds, Illegal Operations and Bad Faith on Part of State Charged in Suit Filed

An order restraining the Internal Improvement Board which has charge of drainage operations in the Florida Everglades from continuing its work and for the appointment of a receiver for the internal-improvement funds has been asked for in a suit filed in Jacksonville, Fla. The bill claims that nearly 2,000,000 acres of the Everglades lands have been illegally given to railroads and other corporations, that nearly \$2,000,000 of the state's trust funds have been illegally diverted and that the Board of Internal Improvement Trustees has used illegal methods in handling the Everglades drainage proposition. The bill further charges that the whole situation is in a bad muddle and cannot under such supervision ever be brought to a successful conclusion.

Bad faith on the part of the state in the conduct of the Everglades drainage is alleged in the suit, and it is claimed that the present bond issue of \$3,500,000 would not be sufficient to carry on any drainage work after the outstanding debts of the board have been paid. The bill further sets forth that it will require fully \$40,000,000 to complete the work.

Wood Preservers' Association Meets in New York

Adopts Specifications for Treating Paving Blocks and for Various Preservatives—More Publicity Urged

Specifications for the treatment of wood paving blocks, agreed upon at a meeting of representatives of various technical associations in Brooklyn last September, and adopted by the American Society of Municipal Improvements in October at the Newark meeting, were adopted last week with minor changes by the American Wood Preservers' Association at its thirteenth annual meeting in New York City. Specifications were also adopted for various common preservatives, as were rules for the purchase and preservation of treatable timber and definitions of the principal preservative processes. Vigorous appeals were made to the society to give timber and its possibilities when treated more and better publicity, which would match that given concrete and other rival materials. It was asked that the society be less fearful of boosting competitors within the timber or preservative field, when giving publicity. Lantern slides illustrated why treatment sometimes fails to prevent decay.

About 100 members and 100 guests registered for the meeting, at which C. G. Crawford, president, presided. F. J. Angier, secretary-treasurer, reported a membership of 300, a gain of 24.

E. A. Sterling, chairman of the committee on publicity, made an ardent appeal along the lines set forth in a preceding paragraph. Later in the convention J. H. Waterman and George E. Rex presented lantern slides showing how ties and other timber have failed, though treated, because of incipient decay induced by improper handling before treatment. Examples of storing on end, and of seasoning in large puddles of water were shown and condemned. It was urged that the abuses as well as the uses of treatment be called to the attention of timber users.

Debate on Specifications

The chief debate of the convention was on the subject of specifications offered for various preservatives which are in common use. Efforts were made by one or two members to induce the association to commit itself as to the relative merits of different preservatives. The committee itself refrained from recommending water-gas tar specifications for paving blocks, prepared by one of the subcommittees. These were adopted by the convention, however, and the only finding reflecting on the relative merits of materials was the qualifying clause adopted some time ago by the American Railway Engineering Association, to the effect that creosote coal-tar solution is recommended only when creosote is not available. The specifications adopted include zinc chloride, both creosote and creosote-coal tar solution for ties and structural timber, and coal-tar oil, distillate oil and water-gas tar for paving blocks.

Objection was raised to the steaming of the blocks, in the specifications of the wood-block paving committee. It was held that the expense was unnecessary, and that the blocks were weakened thereby. Answer was made that steaming prevents bleeding and reduces expansion, and does no harm if the temperature is kept below 240 deg. Fahr.

The specifications were adopted with minor changes. They provide among other things that air-seasoned and green timber should not be treated in the same charge; that both classes should be steamed from 2 to 4 hours at from 220 to 240 deg. Fahr. and held under a vacuum of at least 22 in. for one hour, this to equalize the moisture content, swell the dry cells, and extract the excess water. This will produce even treatment through heart and sapwood with no excess in either, prevent excessive expansion and reduce bleeding. Bleeding will be further reduced by final steaming and vacuum treatment. The blocks should be thoroughly sprinkled in the street before laying.

Other conclusions adopted include rules for the purchase and preservation of treatable timber and definitions of the principal preservative processes. Plant operation was reported on, as were service tests and ties and structural timber, and wood-block paving. A paper by C. P. Winslow on the grouping of ties for treatment was read.

New Officers

Officers for the coming year were elected as follows: President, John Foley, forester, Pennsylvania Railroad; first vice-president, M. K. Trumbull, vice-president, National Lumber & Creosoting Company; second vice-president, J. B. Card, president, Central Creosoting Company; secretary-treasurer, F. J. Angier, superintendent of timber-treating plants, Baltimore & Ohio Railroad; members of executive committee, V. K. Hendricks and C. M. Taylor. The next annual meeting will be held in Chicago.

Improvements Advocated for New Jersey Highways

Without specifying any particular method of raising funds for a state highway system, the County Engineers' Association of New Jersey, meeting at Trenton, Jan. 16, advocated widespread road improvements in the state, made in a systematic manner. Papers having to do with road conditions and engineering problems were read, as well as the final report of the special committee on the regulation of commercial motor vehicles. Bills based on the recommendation of the report will be presented early in the present term of the legislature. It is understood that the provision in the report calling for sealed governors is retained, but will not affect present equipment.

Officers elected for the present year are: President, Jacob L. Bauer; vice-president, James Logan; secretary, Robert Ferguson, Passaic, N. J.; treasurer, Alvin B. Fox.

San Francisco Incinerator Suit Decided

Federal District Court Awards \$160,000 Judgment to Destructor Company—Case Will Be Appealed

The suit to recover \$160,000 from the city of San Francisco for the construction of the Islais Creek incinerator and a portion of the equipment of the North Beach incinerator was decided on Jan. 18 in favor of the Destructor Company in Judge Van Fleet's department of the Federal District Court. M. M. O'Shaughnessy, city engineer of San Francisco, states that an immediate appeal from the decision will be made and the case will be carried, if necessary, to the highest tribunal.

Ordered Work Discontinued

Shortly after work on the Islais Creek incinerator was under way, Mr. O'Shaughnessy became city engineer. He examined similar incinerating plants in the East, and came to the conclusion that the 50 per cent moisture content of San Francisco garbage would make it difficult for the Destructor Company to comply with the specifications. Accordingly, he ordered work on the North Beach plant discontinued until such time as the Islais Creek incinerator could be tested.

The Islais Creek plant was finished and subjected to tests in September and October, 1914, and was then rejected by the city engineer because it did not comply with the specifications. Nuisance was created in its operation, he stated, and obnoxious odors, smoke and dust escaped from the building or the chimney. A report of the tests appeared on page 12 of the Engineering Record for July 4, 1914.

Case Will Be Appealed

On the day following the decision, Mr. O'Shaughnessy said to a representative of the Engineering Record in San Francisco:

"The case will be appealed immediately. According to my understanding of the specifications, the city was to receive a plant that could be operated without nuisance. The Islais Creek incinerator as at present constructed cannot incinerate garbage without producing offensive smoke, dust and odor, and I disagree with the verdict rendered. Many witnesses testified during the trial as to the smoke, dust and odor that emanated from the plant. Mr. King, secretary of the chamber of commerce, stated that he had been actively in touch with the tests and that he did not consider that the incinerator complied with what he had been led to believe the city would receive. Mr. King stated that, aside from the specifications, E. H. Foster, vice-president of the Destructor Company, gave assurance on many occasions that the Islais Creek plant could be operated without nuisance features, which guarantee, in his opinion, was far from being fulfilled."

Engineers Hold Three-Day Convention at Chicago

A three-day convention during "Cement Show Week" at Chicago has been planned by the American Association of Engineers. This is the second annual convention of the organization.

Beginning Feb. 8, at 10 a. m., papers on accountancy and the engineer and engineers as city managers will be presented. A proposed plan for national promotion will be explained by

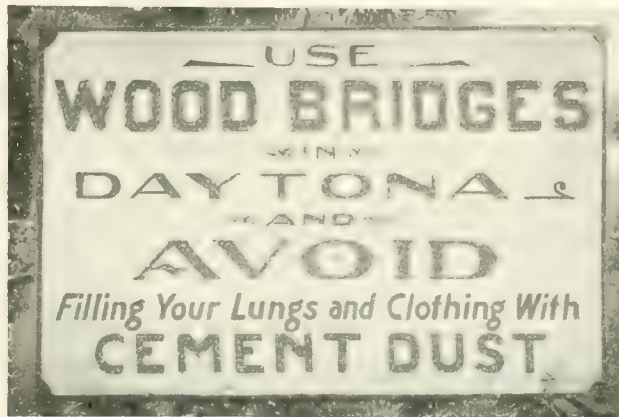
applies to officers and others connected with concerns manufacturing freight-handling appliances and terminal equipment and those whose work and interests enable them to co-operate in the aims of the society. Junior members comprise young engineers and recent graduates who will specialize in terminal engineering.

The partial organization so far effected is: President, H. McL. Harding, New York; vice-presidents, General W. H. Bixby, U. S. A., Washington, and John Meigs, Philadelphia; treasurer,

pier supports. Electric-railway tracks are being laid to connect with the trestle across Hayden Island already built by the Portland Railway, Light & Power Company. The paving of the bridge is already under way.

Cleveland Society Asks Council for Paving Commission

To work out a definite constructive paving plan in expending the \$3,000,000 paving bonds voted last fall, which is the city's share of approximately



Owners of Toll Bridges Adopt Unique Methods to Secure Business

IN an effort to divert traffic over their respective structures, two owners of toll bridges have erected the signs shown at a point where travelers have a choice of routes. The roads over the different bridges lead to practically the same point—hence the competition for the bridge fee, which is 25 cents either way.

A. H. Krom, general manager of the American Association of Engineers. Thursday afternoon has been set aside to allow inspection of the Cement Show, and that evening the association plans to attend the engineering session of the American Concrete Institute.

Friday morning will be devoted to an inspection trip to the new municipal pier, Field Museum, Lake View pumping station and other points of engineering interest. In the afternoon the members will visit the Buffington works of the Universal Portland Cement Company. An informal smoker is planned for that evening.

The tentative program for Saturday includes papers on civil service and the engineer, qualifications for engineers and engineering ethics. The banquet will be held at 6.30 p. m. at the Hotel La Salle.

Form Terminal Engineers' Club

The Society of Terminal Engineers has just been chartered to promote the study of terminal engineering and mechanical freight handling as a specialty.

The organization has three grades of membership—member, associate and junior. The member grade is open to professors of civil and mechanical engineering and engineers specializing in terminal work. Associate membership

W. J. Barney, New York; secretary, J. Leonard, New York.

The office of the secretary is at 1133 Broadway, New York City.

Last Span Is Placed on Columbia River Bridge

The last span of the Columbia River interstate bridge was recently launched and successfully fitted into place. This completes the difficult construction features of the first highway bridge to be thrown across the lower Columbia River. A complete description of the design and construction methods appeared in Engineering Record, July 8, 1916, page 36.

Greatest care attended the placing of the last span, as there was practically no leeway, this span being fitted in between others already anchored in final position. The time required to place the span, however, was less than on any of those previously put into position, only 30 minutes elapsing between the time the span left shore and its location in final position.

All of the spans were built on the north bank of the river just downstream from the bridge site, so that when ready to be placed in position two stern-wheel steamers could push the supporting barges upstream until the span was in proper position above

\$10,000,000 worth of paving, the Cleveland Engineering Society Jan. 18 asked the mayor and city council to appoint a paving commission. It would have authority to make rules under which paving and repaving would be done, and to determine the policy to be pursued in the laying of pavements before or after sewers, gas pipes, telephone tunnels and water mains are placed; also to outline a definite policy in regard to the construction of curb connections, and as to the replacement after the pavements are torn up by public utilities. It is suggested that the commission consist of three paid expert paving engineers giving a portion of their time to the city, or that the commission be made up of citizens serving without pay, the majority to be engineers. In both cases the commission would work in conjunction with the city engineer. On account of the large amount of work proposed the society recommends that the city engineer have as one of his assistants a thoroughly trained and experienced expert paving engineer.

THIS WEEK

Prices of construction materials—Review of conditions indicates increased building activity. See First Page of Contracting News.

Illinois Society Discusses Professional Ethics

Attention Given to Professional Problems at Annual Meeting in Chicago

A constitutional change providing for sections with halved dues and non-technical membership requirements, as outlined in the address of the president, Paul Hansen, was the most important thing accomplished at the thirty-second annual meeting of the Illinois Society of Engineers held Jan. 25 and 26 in the rooms of the Western Society of Engineers in Chicago. The liveliest discussions related to ethical, material welfare and professional unity subjects, rather than to the twenty-three technical papers and reports on the program.

Baker Pavement Report

For more than thirty hours the committee on resolutions, headed by John W. Alvord, wrestled with the matter of the investigation of the Ira O. Baker pavement report as called for by C. D. Hill of the Chicago Board of Local Improvements; but its recommendation to have the question considered by a committee consisting of Professor Baker, a member of the board, and a third disinterested inquirer was not accepted. The whole proposition finally was placed in the hands of the executive board.

The principle of the consolidation and readjustment of state departments now under consideration in the state legislature was concurred in and the legislative committee was authorized to urge the governor to recognize engineers in making appointments to the departments having to do with engineering.

Prof. F. H. Newell, in his address on "Co-operation in Engineering," sounded an apparently popular note, for it was referred to frequently at each of the succeeding meetings. Co-operation for legislation, publicity, employment and ethics were the lines he emphasized (see Engineering Record, Jan. 27, page 146).

Fees and Ethics

The committee on fees and ethics, J. W. Dappert, chairman, sent out a questionnaire, but received only fifteen replies. These indicated to C. B. Burdick, who presented the report, that there was not so much dissatisfaction after all. As to ethics, the fundamental basis is the Golden Rule elaborated. College professors were urged not to take smaller fees than their competitors. The question of public officials taking on consulting work was held to be one between the employer and employee only. Nothing definite in regard to fees was proposed. In fact, any definite scale limit was frowned upon.

G. C. Habermeyer, of the State Water Survey, described the experiments on a study of the removal of iron for the well-water supply of Springfield, which has an iron content of 1 to 3.4 parts per million. The process was to remove oxygen by simple pan aerators and to

remove the CO₂ by lime. Prof. Edward Bartow added the information that experience at Anna and Mount Vernon indicated that manganese would not come out under the same treatment until the sand grain had been coated with manganese dioxide. S. A. Greeley in his committee report on sewerage and sewage disposal discussed the feasibility of having an interim meeting for operators of sewerage systems and sewage-disposal plants. "Operation of a Sewerage System," a paper by M. H. Brightman, city engineer, Elgin, outlined inspection methods and asked for the invention of a simple periscope instrument to look into sewers from the street level.

Sewage-Disposal Plants

M. C. Sjoblom, assistant engineer, State Board of Health, gave startling results of a winter inspection trip to eight sewage-disposal plants, few of which he found operating with any efficiency. He stated that the present haphazard manner in which most of these plants are operated is lamentable. The persons chiefly to blame are the municipal authorities, who are actuated by a desire to keep down expenses, or more often through ignorance. He suggested that engineers who design plants provide framed instructions for the operation of the plant in addition to instructing the proper officials. Retention of the engineer for a year's operation period was also urged.

Roads and Pavements

Road material interests came in for much credit for the rapid development of many phases of construction in the report of B. H. Piepmeyer, chairman of the committee on roads and pavements. It is being realized more and more, he stated, that all materials have their places, and that the selection of the type most suitable to the traffic condition is a boost for all concerned. In new methods Mr. Piepmeyer noted the bituminizing of soft shale or even clay brick for road construction. Experiments indicate that the softer brick may be made to stand abrasion and is almost on a par with the higher grade shale brick. Answers from forty-five cities indicate that the major number use a 5-in. concrete base with a sand cushion under the brick, and a 4-in. base when the dry-mortar cushion is used. The yardage is equally divided between bituminous, cement and sand fillers.

Professor Talbot supplemented D. A. Abram's remarks on the advantage of getting the proper amount of water in concrete, with data showing materially increased strength in three-year specimens kept in moist sand. S. M. Woodward described the surveys for the flood control in Miami Valley and showed slides of the hydraulic experiments with the model for obtaining standing wave data.

The newly elected officers are as follows: President, W. D. Gerber; vice-president, J. G. Melliush; new trustees, Robert I. Randolph and F. W. De Wolf. Quincy was chosen for the next meeting place.

What Engineers and Contractors Are Doing

T. RUSSELL HOWARD has accepted the position of resident engineer, Real Estate Development & Construction Corporation, Petersburg, Va.

C. S. RINDSFOOS has become associated with the Jarrett-Chambers Company, Inc., engineers and contractors, New York City. Mr. Rindsfoos was secretary and treasurer of the Foundation Company until about two years ago, when he resigned to organize the U. S. Purchasing Corporation. He will continue to be a director of the latter company, but will devote his activities to the Jarrett-Chambers Company, specialists in the design and execution of difficult underground work and industrial plants.

S. E. STOUT has been selected as efficiency engineer with the Whiting Foundry Equipment Company, Harvey, Ill. Mr. Stout since his graduation from Purdue in 1910 has had several years' experience in efficiency work with the American Bridge Company and with the Cook County (Illinois) Civil Service Commission.

GEORGE L. KELLY, for seven years structural engineer and estimator with the American Construction Company, Houston, Tex., is now with the Heller Brothers Company, general contractor, Houston, in charge of the estimating department.

O. W. HEAD, who has been connected with the Connecticut State Highway Department as division engineer for nearly four years, has resigned to become secretary of the Robert D. Daly Company of New Haven, Conn. Mr. Head started work as an engineer in April, 1898, with the Boston & Maine Railroad and continued in that capacity until June, 1903, when he became identified with French & Hubbard, Garvins Falls, N. H. Later Mr. Head was employed by the engineering department of the New York, New Haven & Hartford Railroad. When he left that road to assume the position of division engineer with the state highway department he was assistant engineer in charge of construction.

C. P. DEXTER, former assistant engineer, King County, Washington, has been engaged to take charge of office work with the Port Angeles & Grays Harbor Railway Company.

C. H. LAWRENCE has been appointed city engineer of Warren, Ohio. Mr. Lawrence was formerly head of the paving department and now takes the place left vacant by the resignation of H. McKibben.

JAMES S. SHUTE has resigned as construction engineer with the E. E. Smith Contracting Company, New York City, to accept the position of division engineer, Department of City Transit, City of Philadelphia. Mr.

Shute was engaged on subway work in Philadelphia from 1903 to 1909, spent one year with Board of Water Supply as assistant engineer and was with the Smith Contracting Company for nearly seven years.

JOSEPH E. KUHN, Brigadier-General, U. S. A., has been made president of the War College and assistant to the Chief of Staff. He was recently promoted from the rank of colonel in the Corps of Engineers.

MALCOLM PARLIN has been appointed county engineer of Leavenworth County, Kan. He is a graduate of the University of Kansas and was recently assistant engineer of Leavenworth.

FREDERICK B. HARRIS, civil engineer, U. S. N., Chief of the Bureau of Yards and Docks, has been named by the President as rear-admiral, under the new law which provides for five staff officers of the navy with the rank of rear-admiral. His list rank was lieutenant-commander, but he has had an ex-officio rank of rear-admiral by virtue of his position as chief of bureau.

HOWARD C. PHILLIPS, recent assistant general secretary of the President's Conference Committee on federal valuation of railroads, has been appointed secretary, succeeding Thomas W. Hulme. Mr. Phillips was graduated from Princeton University in 1890. In 1893 he was assistant engineer for the New York, New Haven & Hartford Railroad and was later engaged on track elevation work in Boston. In 1898 he went to New Mexico on location surveys for the Pecos Valley & Northeastern Railroad. He soon joined the engineering corps of the Atchison, Topeka & Santa Fé Railway and was promoted through various grades to the position of chief engineer of the company's coast lines at Los Angeles in 1906. In 1912 he was made valuation engineer of the company with headquarters at Chicago.

THOMAS BENTON HAMILTON has been elected resident vice-president of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, with headquarters at St. Louis. Mr. Hamilton was graduated from Princeton University in 1888 and entered railway service in the same year as a rodman on the Jeffersonville, Madison and Indianapolis Railroad. From Jan., 1890, to Jan. 1912, he held the positions of assistant engineer, engineer of maintenance of way and division superintendent with several different railroads. On the latter date he was appointed general superintendent of the central system of the Pennsylvania Lines West of Pittsburgh and in Jan., 1914, was promoted to general manager of the Vandalia Railroad Company.

RAMÓN RAMOS CASELLAS, city engineer, Arecibo, Puerto Rico, from 1905 to 1915, and resident engineer Department of the Interior of Puerto Rico to 1916, has been promoted to the position of construction engineer. He will have charge of all

bridge and road work under construction by the government of Puerto Rico. Mr. Casellas was graduated from the Institute Provincial de Puerto Rico in 1899 and from the Rensselaer Polytechnic Institute in 1905. Later he introduced concrete pavements in Puerto Rico, building the first street in Arecibo in 1906.

CAPT. G. E. EDGERTON, Corps of Engineers, U. S. A., who has been in charge of the engineering depot, U. S. Army, at El Paso, Tex., since its organization in July, 1916, has been relieved of that duty by Major R. T. Ward, Corps of Engineers. Captain Edgerton is assigned to the Second Regiment of Engineers, in Mexico.

Obituary Notes

RICHARD B. DOLE, of the U. S. Geological Survey, died in Washington, Jan. 21, after a brief illness. He was born May 8, 1880, at Portland, Me. In 1903 he took a graduate course in chemistry at the Massachusetts Institute of Technology, and in June of that year he was appointed engineering aid in the U. S. Geological Survey. At the time of his death he was chemist in the water resources branch. Mr. Dole made sanitary surveys of rivers in Iowa and Indiana, an investigation of the sanitary and mineral quality of the surface waters of Minnesota, a chemical survey of the ground waters of the San Joaquin Valley in California, and a sanitary inspection of Glacier, Yellowstone and Yosemite national parks. He also had charge of a general investigation of the chemical composition of surface waters throughout the United States, as well as supervision in the survey of all matters dealing with the quality of water. In 1909 he was detailed to the State Department and was sent to Ecuador as agent in charge of the U. S. Government exhibits in the National Ecuadoran Exposition. Mr. Dole wrote many reports and papers on the quality of waters, including a chapter on water for industrial purposes in the "Manual of Industrial Chemistry," by Rogers and Aubert.

EUGENE L. HURLEY, assistant to the valuation engineer of the New York Central Railroad, Buffalo and East, died Jan. 6 as the result of an operation. Mr. Hurley was born in Rahway, N. J., Aug. 4, 1875, and was a graduate of Rutgers College. He entered the service of the New York Central & Hudson River Railroad in March, 1900, as assistant engineer, maintenance of way department at Kingston and Weehawken. He was later transferred to Albany and returned to New York in 1905, where he remained until the time of his death. In 1911 he had direct supervision of the forces engaged in the so-called Swain valuation of the railroad east of Buffalo, and in 1913 he joined the present valuation forces. Mr. Hurley resided in Armour Villa Park, Yonkers, N. Y.

Construction Machinery Export Company Organized

The American International Corporation has formed a new subsidiary to introduce throughout the world the labor-saving construction machinery which has been so highly developed in this country. The new organization is to be known as the Allied Construction Machinery Corporation, with its home office in New York City. Branches will shortly be established in various countries where the markets are most promising.

Among the American trade the machinery involved in the plans just announced is known as contractors' plant and equipment. This includes concrete mixing and distributing plants, derricks, air compressors, hoisting engines, power shovels, road-building machinery, trench-digging machines, light railways and similar products. Manufacturers in the United States have more or less unconsciously led the world in the development of such machinery. In fact, much of this class of machinery is not used elsewhere at all.

Markets

Since the war began, some of our high-speed, labor-saving construction machinery has been sold in France, England and Russia. The success of this machinery and of that sold in other parts of the world indicates a broad, immediate market. Moreover, the reconstruction period in Europe is expected to offer an exceptional opportunity.

Larger and more permanent markets are, however, considered to be likely in countries which may be developed in the way the United States has grown. For example, much of virgin South and Central America can be opened up rapidly and most economically only by the use of American construction machinery and methods. The same applies to European Russia.

Although these large market opportunities evidently may be opened up, no single American manufacturer can afford to undertake the promotional and educational work necessary to develop them. In accordance with the basic policy of the American International Corporation, of assisting interests here under such circumstances, the new subsidiary was formed. Arrangements have been made to represent several of the more important non-competing manufacturers of construction machinery, and additional lines are to be taken on later. The many connections and representatives of the parent company will be available in perfecting the new organization.

R. P. Tinsley, secretary and treasurer of the American International Corporation, has been elected president and S. T. Henry, formerly second vice-president of the McGraw Publishing Company, has been elected vice-president and general manager of the Allied Construction Machinery Corporation. An appreciation of Mr. Henry will be found on the first page of this section.

Price Advances Led by Cement and Rope

With Prospects for a Busy Construction Season, Advance Demand Seems to Be Affecting Prices—Freight Situation Still Acute

ALL COMPILATIONS of building statistics agrees that permits issued during last December were unusually heavy for that month. According to one set of statistics, permits were not only heavier than in the same month of 1915, but considerably greater in 20 leading cities than permits issued during any December of this century. The volume of projected factory construction is running fully double previous high records, according to this authority, who concludes that while this class of construction may decline during the year the spring of 1917 is likely to prove the busiest building season every known. Anticipation of this condition is doubtless reflected in numerous advances which have occurred during January in the prices of various construction materials. The most notable of these, and the one cutting the largest figure in the cost of construction work is the continued gain in cement values. Other concrete materials and common brick also show gains, while manila rope has advanced in every section of the country, and users of automobile trucks are paying generally increased prices for gasoline.

Exports of merchandise set another new record during December, and the activity of general business continues to be extraordinary. Railroad traffic is still heavier than the lines can handle, although the pressure has been relieved to some extent by the fact that a large part of the 1916 crops has been moved to market. Lumber mills in the West report, however, that the car situation continues to be the worst in their experience, and southern lumber mills note but little improvement during the month.

Iron and Steel

The earnings of the United States Steel Corporation, just announced, exceeded for the last quarter of 1916 even the extraordinary records made in the first three quarters of last year, reaching a total of almost \$106,000,000 and more than doubling the earnings for the December quarter of 1915. After declaring an extra dividend on its common stock, the corporation still has a surplus of more than \$69,000,000 for the quarter.

According to the *Iron Age*, there are as yet no signs of a change to easier conditions in the steel trade. Domestic demand is extending and there is a flood of foreign inquiry for rails, rolling stock and plates. Although the steel-making capacity of the country has been greatly increased, the difficulty of shipping coal, coke and steel products has curtailed production until the present output of pig iron is at a rate below 39,000,000 tons a year. It is not considered likely that production will begin to catch up with demand for some time.

The amount of structural business awarded since the first of the year has surprised even those connected with the trade, many contracts involving large tonnage having been closed. Under the conditions outlined, prices have continued to advance, though the increases are not so general or so marked as those which occurred during December. This is especially true of pig iron, which appears to have settled down at the high figures reached at the beginning of the year.

Pig Iron—Prices per ton recently quoted are as follows:

New England	\$30.50
New York	24.00
Pittsburgh	24.00
Chicago	24.00
St. Paul	24.00
Los Angeles	24.00

Steel Products—Prices of steel products given below are per 100 lb. at the mill or warehouse:

Product	Immediate Delivery	Future Delivery	Warehouse
Structural material		\$3.25	
Plates	\$5.00	3.75	
Steel bars		3.00	
Iron bars	3.50	3.25	
Rivets		1.25	

New York:			
Structural material	3.669	3.419	\$3.95
Plates	5.169	3.919	5.00
Steel bars	3.669	3.169	3.85
Iron bars		3.169	3.70
Chicago:			
Structural material	3.689	3.439	3.85
Plates	5.189	3.939	4.50
Steel bars	3.439	3.189	3.75
Iron bars	3.25	3.00	3.75
Rivets		4.15	4.50

Sheets—Black sheets, No. 28 gage, have advanced slightly, but galvanized sheets of the same gage remain unchanged. Prices quoted below are per 100 lb. at the points named:

	Black	Galvanized
Pittsburgh	\$4.50	\$6.25
Chicago	4.75	6.50

Rails—Prices per ton, f.o.b. the points named, remain as follows:

	Open Hearth	Bessemer
Pittsburgh	\$40.00	\$38.00
Chicago	40.00	38.00

Cast-Iron Pipe—Prices per ton for cast-iron pipe in carload lots have remained steady during the month at the following figures:

	Class A and Gas Pipe	Class B and Heavier
New York	\$42.50	\$41.50
Chicago	42.50	41.50
Birmingham	37.00	36.00

Wrought Pipe—Prices in carload lots, f.o.b. Pittsburgh, for lap-welded steel and iron pipe, plain ends, remain as follows:

	Black	Galvanized
Steel pipe, 2½ to 6 in.	\$80.00	\$105.00
Iron pipe, 2½ to 6 in.	102.00	128.00

Concrete Materials

Cement—Prices have advanced throughout the central and eastern states, apparently under increasing demand and the prospects of a busy season. Those quoted below are to contractors, per barrel, f.o.b. the points named, not including sacks:

Boston	\$2.00	Duluth	\$1.81
New York	1.67	St. Paul	1.83
Pittsburgh	1.66	Cedar Rapids	1.79
Cleveland	1.79	Kansas City	1.64
Atlanta	1.62	Houston	1.65
Cincinnati	1.80	Denver	1.99
Detroit	1.75	Salt Lake City	2.37
Chicago	1.56	Phoenix	2.85
Jacksonville	1.70	Seattle	2.20
New Orleans	2.10	San Francisco	2.00
Memphis	1.79	Los Angeles	2.00

Sand—Prices quoted below are in large lots to contractors, f.o.b. the points named:

Boston	\$0.80	Houston	\$1.00
New York	0.50	Denver	0.75
Cincinnati	*0.75	Salt Lake City	0.70
Chicago	1.25	Phoenix	1.00
New Orleans	1.10	Seattle	0.75
St. Paul	0.50	San Francisco	*0.70
Kansas City	0.60	Los Angeles	0.75

*Per ton.

Gravel and Crushed Rock—A number of advances over prices prevailing at the first of the year are noted. Prices given below are per cubic yard to contractors in large lots, f.o.b. the points named:

	Gravel ¾ in.	Gravel 1½ in.	Crushed Rock ¾ in.	Crushed Rock 1½ in.
Boston	\$1.20	\$1.10	\$1.25	\$1.25
New York	1.10	1.10	1.20	1.10
Cincinnati	*0.75	*0.75	*0.95	*0.95
Chicago	1.25	1.25	1.15	1.15
New Orleans	1.70	1.55	4.00	2.50

Price advances are indicated by heavy type; declines by italics.

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The Nation the Gainer

THE National Foreign Trade Council and the Chamber of Commerce of the U. S. A. have held their annual conventions in the last two weeks. The meetings were extraordinary in the number and high standing of the business men present, particularly when neither organization can boast of more than six years of existence—the Foreign Trade Council, in fact, of only four. Both organizations have afforded the business interests of the country an opportunity to render a great national service, and these interests construing the opportunity as a duty have responded promptly to the invitation of the founders of these bodies. Though young, they bear none of the earmarks of youth. Guided by the best business brains of the country, they have, it would seem, been born mature, and each is dealing with unusual vigor with the problems within its special scope. One cannot fail in attending the meetings of both to be impressed by the spirit of unselfish co-operation which is dominant. Big interests and small interests share freely their respective experiences, and the thought is frequently expressed that the interests of the country can be served only as there is general progress, general prosperity. The big interests through these meetings give their valuable experience, and learn in turn to sympathize with the problems of the smaller business. Little business, on the other hand, gets not only valuable information and a broader outlook, but, by close view and contact, gets at the true spirit of the directors of big business, with the result that what antagonism it might be inclined to have against big business is dispelled. The result is that the nation is reaping large returns—for business prosperity means the prosperity of the individual.

A Conflict of Dates

AS SCHEDULED the hearing on the government's tentative valuations will be resumed March 19. The Interstate Commerce Commission is probably aware that of the men who sacrificed their time last week and came from all parts of the United States to pack the hearing room to overflowing, a large percentage were engineers. Possibly it has not been brought to the attention of the commission that on March 20 begins the annual meeting of the American Railway Engineering Association, the convention of the year that railroad engineers are most anxious not to miss. Present at the hearing were at least six past presidents of the association, one of whom is in the government service. Members of important committees were also there. Technically, of course, these men, with the exception of the

one, are not interested parties in the discussion and the hearing could go on as well without them. Practically, they are all vitally interested in the general principles woven into the whole discussion—so much interested that many of them, if the conflicting dates remain, are likely to have to forego the convention, to its great detriment. This journal hopes that it will be possible for the commission to change the date of the hearing.

Time for Discussion

THE formal program will be brief, most of the time being available for discussion." So read the announcement in the Engineering Record recently of the coming meeting of the Iowa County Engineers' Road School and Convention, to be held at Ames. We can heartily commend the plan to the many organizations which insist upon overloading their programs, and consequently, instead of treating one or two subjects well, treat many subjects badly. A brief formal program with plenty of time for discussion is particularly desirable at the type of convention that will be held at Ames. In general, however, the same course can be followed to advantage by engineering societies.

K-Trusses Analyzed

DESIGNING engineers will find of more than usual value the complete, yet definite and concise, analysis of the K type of truss made by C. L. Warwick and presented in two parts, the first of which appears in this issue, page 223. Mr. Warwick assumes a truss outline resembling the well-known Quebec cantilever bridge, but makes the treatment general by changing the panel layout and using unequal sub-panel lengths. The truss is treated first as a simple span and then as a cantilever arm (Part II), and influence lines for a typical panel are completely determined. Criteria for maximum stresses are developed and the methods for obtaining such maxima are outlined. The resulting series of equations and influence lines will enable the analysis of any K-truss to be completed by the most direct and concise methods now available. Of special interest is the comparison made by Mr. Warwick to show the difference in action between the K type of secondary system and the usual Pettit-truss secondary system, both statically determinate, but resulting in entirely different distribution of the intermediate panel loads to the main panel points. While the field of application of the K-truss is limited by economy to long spans, Mr. Warwick's analysis should result in more general use of this type, particularly for cantilever bridges.

Federal Valuation and Its Problems

SPACE will not permit more than brief comment on the valuation hearing at Washington all of last week, based on the Valuation Division's first two tentative valuations. A multitude of interesting points were raised. The question of joint property, with all its ramifications involving trackage rights, joint stations, crossings and industry tracks, is in itself one to command much study—as it is evidently one on which none of the parties at interest are ready to declare themselves with too much definiteness. Two subjects, however—and they are probably the two most important, unless subsequent developments bring “other values and elements of value” forward as a candidate—have been discussed and rediscussed, and it is unfortunate that there remain such totally different views thereon. They are the subjects of depreciation and land.

In the matter of depreciation, the carriers, clinging to the idea of one value only, professed to believe that the mere recording of theoretical depreciation means the writing off of possibly 20 per cent of their property. What this journal regards as the answer to this view never seems to be succinctly stated. Director Prouty all but stated it, and the comment of several of the commissioners indicated that they had it in mind. It does not seem possible, however, that the carriers could find a ready answer to the suggestion that the Valuation Act aims to determine sale value as well as value for rate-making, and that the carrier itself would hardly be willing to confine its investigation of a feeder line it sought to buy to an examination of its operating efficiency, ignoring consideration of whether its bridges and stations were good for a long life or would soon have to be replaced. Certainly under such conditions accrued depreciation is a liability.

On the other hand, the attitude of the Division of Valuation is not made more clear when Mr. Farrell, the solicitor, reads from a decision that the deduction of depreciation is proper in rate cases, especially when the decision quoted refers to an entirely different type of property, in which the replacement method of renewals is hardly applicable. Neither, probably, are the carriers reassured by the various views and decisions of state commissions, a composite of which would seem to mean that they believe it right, but frequently not expedient, to deduct depreciation.

Presumably, it is the uncertainty of the carriers as to what use will be made of this depreciation when it is found that prompts them to feel that if it is not found it cannot be used. It is being found, however, and perhaps the carriers could better combat the accuracy of the figures than the existence of what they represent. In saying this, this journal hardly needs to repeat that it believes that the rate base for a properly maintained railroad should be based on 100-per cent value.

Coming to land, the Engineering Record still maintains that the Division of Valuation is not meeting the issue. The division may believe that the Minnesota rate decision renders the reproduction cost of land useless. If that is the law, this journal believes the law should

and will be changed. But the Valuation Act says reproduction cost is to be determined, and when the solicitor argues against the determining of a figure that he deems useless on the ground that the Supreme Court has said it cannot be determined, and strives to exclude testimony that might show it can be determined, he appears to be hiding behind a technicality—and in a case involving perhaps a billion dollars. The Supreme Court can manifestly reject one valuation after another as based on conjecture. But can the Supreme Court itself declare a thing impossible, and establish it as such beyond appeal? Is that not a matter of fact and not of law? The carriers can produce volumes of evidence showing that railroad land usually does cost far more than the average acreage value. If they desire to, should they not be heard?

The Engineering Record regrets that Director Prouty, who gave evidence at the hearing of having a definite reason for practically everything he was doing and who seemed to be willing without too much citation of legal precedents to explain those reasons, did not set forth his own views on this particular question. It hopes, however, that it interpreted the signs correctly, that the commission will adopt the same policy the division has adopted with regard to depreciation—that of recording the facts—and leave to the future whether those facts, under the law as it then is, will be of any use in determining value.

Franco-American Trade

CLOSER study of the requirements of the French market, more generous handling of credits, suitable adjustments in the American schedule of tariffs on French imports and an adequate merchant marine are among the things this country needs to become an important factor in European reconstruction after the close of the present war, according to the report of the American Industrial Commission to France, sent abroad last fall by the American Manufacturers' Export Association.

It is pointed out in the report that there can be no extensive foreign trade without an exchange of goods. At the present time many of the commodities sent to this country from France are classed by the United States Government as luxuries, and taxed accordingly. These articles include products of some of the largest industries in France, and it is natural that from the foreign point of view our import duties on them should seem exorbitant. It is pointed out that France has had for some time a maximum and minimum tariff, which has enabled it to bargain with other nations in conducting its foreign trade, and that the United States is practically the only important country against which all of the maximum duties are still in force. The report expresses the hope that the newly created tariff commission will be able to adjust this situation so that more cordial relations can follow.

The report points out that many hundred million dollars' worth of industrial reconstruction must be un-

dertaken in France alone on the declaration of peace. The building materials, supplies, machine tools and finally much of the raw material to enable the new plants to begin operation should naturally be supplied from this country. However, the sales will have to be made to a large extent on credit. The report makes it plain that, while the French business man is one of the best credit risks in the world, the treatment accorded him when he has sought to purchase supplies in the American market has so far not been of a character to induce him to extend trade relations with us beyond the point of his absolute necessities.

These facts are brought home to the reader in a thorough and convincing manner, which leads one to expect that the publication and circulation of the report will do much to remove the causes of friction referred to. The commission was furnished with extraordinary facilities for inspecting conditions in all the industries throughout France, and much detailed information is to be found in the document which will be of great value to Americans interested in this market. One cannot read the report without feeling that the size of the opportunity placed before this country by the extraordinary conditions prevailing abroad has been grossly underestimated.

The Compensations of War

WE have broken off diplomatic relations with Germany. Possibly before this issue reaches its readers we shall be at war. We do not desire war, but we embrace it willingly as the lesser of two evils—the alternative being the sacrifice of our national honor.

But if war comes, will it be an unmixed evil? If we are to judge by the conditions we find in England to-day we shall have to answer "No." For the result that we shall describe the price is indeed high, but the result is none the less good, and it comes, as one might say, as a byproduct of the great calamity.

While the British press and British citizens may not say it in so many words, they admit, by recognizing clearly the conditions, that England was, industrially at least, decadent before the war. The employees had the upper hand industrially. Apprentices and output were restricted. Trade secrets were closely guarded and played as trump cards by the men in case of disputes. England was being strangled, and Germany was beating her in the markets of the world.

Nor were the employers guiltless. In fact, it is the Engineering Record's deliberate opinion that they, not the employees, were primarily responsible for England's industrial decadence. By and large, they did not pay a living wage, and they persistently held to the exploded doctrine that low production costs are to be attained by low wages. They did not recognize that insanitary working conditions, insanitary housing, underfed employees cut down production. They cared nothing for the condition of the worker. Under those conditions the worker had no reason to be interested in the success of the employer. The employer was not interested in him.

Furthermore, scientific research, scientific study of production processes were almost unknown (the word "almost" might with justice be omitted) in British industry. Consequently new methods were not being introduced which would so increase production as to permit of the better payment of labor.

Then came the war, and both sides have been forced to see their errors. The restriction of output of the men was shown up glaringly. On the other hand, the low production was found by government supervisors to be due, also, to the underfed condition of the workers and to impaired vitality caused by insanitary surroundings in home and shop, the underfed condition and the deplorable housing, of course, being attributable to the less-than-a-living wage. Also came the revelations regarding the neglect of research by the industries, which stamped England's industrial leaders as living in the spirit of a past age.

How much of the improvement made as a result of these discoveries will be permanent only the future can answer. The probabilities are that—though not without stress and strife—the higher wages and the better working conditions will persist, that scientific research will go forward in every industry.

Now, how stands the matter with us? Do we need awakening industrially? The answer is "Yes"; and though war will be a stiff price to pay for the awakening, we may as well accept the byproduct and take it as some compensation for the sacrifices we shall have to make.

We are, of course, not as badly off as England was. Yet in this country, too, the Engineering Record holds, the employer must take a new point of view with reference to his employees. Much of the present dissatisfaction, as indicated especially in the railroad labor situation, is due to the obtuseness of the employers. They have not dealt broadly with the human factor. The treatment, generally speaking, has been such as has been forced by the workers.

Again, we have much to learn regarding the place of research work. The metal and chemical industries have made good progress; the others, with here and there exceptional plants, hardly any.

If war comes, a new light may break for both employer and employee. Already, as a result of handling European war orders, many plants have learned how to double and treble output—and note that the wages are high. If now our own government enters the market on a large scale she will undoubtedly set about standardizing as England did, with the result that the deficiencies of employer and employee will be shown up.

The Engineering Record does not hold this will be the only compensation. England and France, and, in a measure, Germany have had a moral awakening, and surely we need that too. That would be the greater good, but the engineer's province concerns the relations of employer and employee so directly that we have chosen to dwell rather on that one of the many compensations which the impending calamity is likely to bring to this nation.

Fishing Creek Station Develops 44,000 Horsepower Under 50-Foot Head

Timber Forms for Concrete Intakes and Scroll Cases Built as Separate Units—Gates Operated by Wire Ropes on Drums

WHEN, on Nov. 21, 1916, the first power was turned out of the new Fishing Creek plant of the Wateree Power Company, located about 3 miles north of Great Falls, S. C., it marked the successful completion of a station containing five units of the single-runner vertical type developing 8800 hp. each under about 50 ft. head. Outdoor-type transformers and a steel-frame switching structure were used to decrease cost, while at the same time affording better switching arrangements. In the construction of the dam and the power house, both built of cyclopean concrete, the forms for concrete scroll cases, intakes, draft tubes and the fifty sand gates were rapidly built in separate units in the carpenter shop and yard located below the power house. Other special features include the use of wire rope and drum hoists for operating gates and the rack framing of an arch type claimed to effect large economy.

The Fishing Creek station is one of three new plants of the Southern Power Company located on the same watershed of 4000 square miles drainage area—the Lookout Shoals plant completed about one year ago, the Fishing Creek plant just put into operation, and the Bridgewater station, for which two 15,000-hp. units have already been purchased. The features which especially distinguish the Fishing Creek plant will

here be considered. It is of interest to note that the scroll cases for the Lookout Shoals plant are of riveted steel, those for the Bridgewater plant of cast iron, and those at Fishing Creek of reinforced concrete. The reason for these differences is that the Fishing Creek plant has only a 50-ft. head, while Lookout Shoals and Bridgewater have 85 ft. and 135 ft. respectively.

GENERAL DIMENSIONS

The total length of the dam and power house is 1800 ft., with 1130 ft. of spillway section—a dam 48 ft. high proportioned as shown in a drawing herewith. The twelve flood gates, each 10 ft. wide, are located next to the power house, which is 255 x 60 ft. in plan. Thus the total additional width of flood-water area is 120 ft. and at maximum high-water level a total of 350,000 sec.-ft. is estimated as the available waterway, including that over the spillway section.

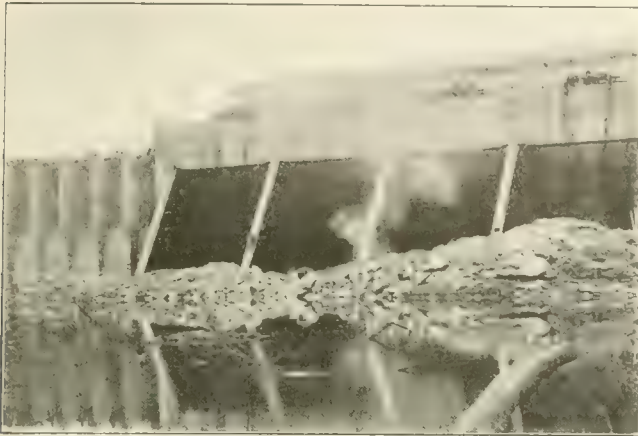
At normal level the dam creates a pond about $4\frac{1}{2}$ miles long and impounds about 20,000 acre-feet.

DESCRIPTION OF TURBINES

Each unit is a single-runner vertical turbine rated at 8800 hp. at 97 r.p.m., coupled to a 6600-volt 6000-kw. generator, with individual exciters mounted above.



PROGRESS VIEW ON OCTOBER 1—CARPENTER SHOP AND YARD IN FOREGROUND FOR BUILDING UNIT FORMS



FLOOD-GATE AND HEAD-GATE HOISTS ABOVE RACKS

Water governors are used. Each unit requires 17 gal. of filtered oil per minute, furnished by a gravity system. To handle the machinery an 80-ton electric crane is installed on the runway shown in the cross-section of the power house.

Following the usual practice of the engineers of the Southern Power Company, of which the Wateree Power Company is a subsidiary, the turbines were first purchased, thus definitely fixing the dimensions for the concrete foundations, intakes, scroll cases, draft tubes, etc., of the power house, the construction of which is always begun first to insure the completion of the generating plant by the time the dam is closed. In this way power can be turned out immediately after such closure is made. Generators, switchboards and all electric equipment are also purchased early, thus fixing all power-house details, including ventilation passages, etc., at the time the first design is made.

REINFORCED-CONCRETE SCROLL CASES

One of the distinctive features in the construction of the power-house foundations is the construction of the reinforced-concrete scroll cases by the use of timber forms placed as units on prepared concrete bases, clearly shown in the photographs and in the front-cover picture. By concentrating all the carpenter work in a shop and yard a short distance below the power house, rapid construction of the forms was attained and the units were easily handled at the site by derricks. In this way the placing of cyclopean concrete and the 1-in. square rod reinforcement was greatly facilitated.

As indicated in the photographs, the construction of the power house and dam was carried out by the use of guyed derricks of 115-ft. masts and 100-ft. booms, made by the Minneapolis Steel & Machinery Company. The derricks were built on timber cribs, and cofferdams above and below the site were constructed of similar timber cribwork filled with rock and puddled with clay.

POWER HOUSE AND SPILLWAY

The general dimensions and the relation between the power house, flood gates and spillway section are indicated by the photographs and drawings, the power house being at the north end of the dam. The bottom of the flood gates is 10 ft. below the crest of the dam, and the gates can be raised to a level of the crest of the spillway, thus furnishing a flexible control for the head acting on the turbines.

One of the interesting features of the dam is the installation of special cups at the rock foundation and connected by pipe lines to the longitudinal inspection gallery. By means of these cups it is planned to measure the water pressure under the dam and obtain valuable data regarding the amount of uplift.

Another feature is the use of fifty so-called sand gates, or 4-ft. passageways, through the dam for the purpose of cleaning the bottom of silt, etc. They also act as diversion channels for the water of the river during construction and closure. These are indicated in the cross-section of the dam.

GATES OPERATED BY WIRE ROPES

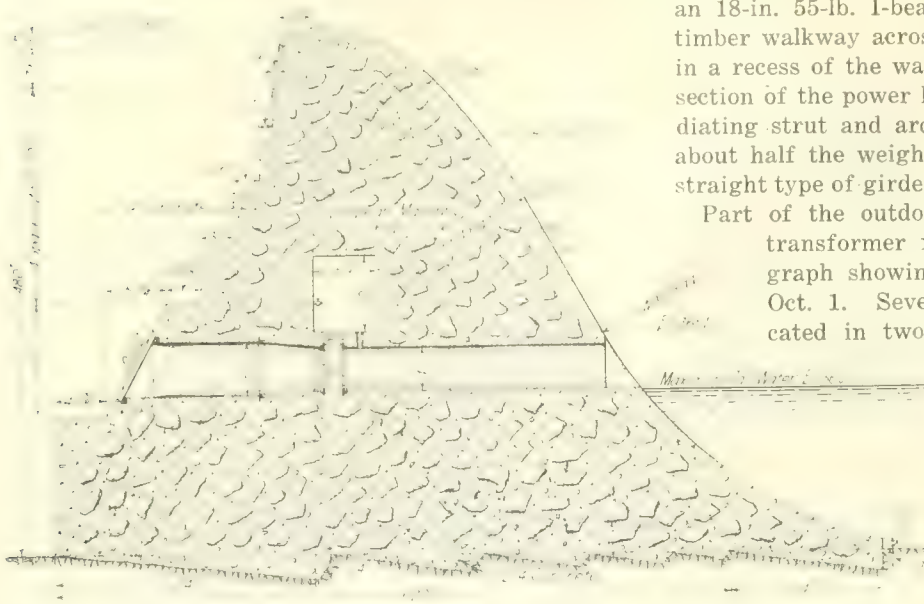
Both the head gates and the flood gates are operated by special mechanism designed to raise or lower them by $\frac{3}{4}$ -in. wire ropes and 14-in. sheave blocks. The head gates are 21 x 27 ft. in size, of steel frame construction, filled with concrete, and weighing 216,000 lb. total in air or 156,000 lb. when immersed. A double drum operates the rope cables attached to these gates at two points 13½ ft. apart and passing through 5-sheave blocks and equalizers. The drum shafts are geared to a long shaft driven by a 75-hp. motor near the center of the group of five units.

The flood gates, each 10 x 14 ft. in size and about 22 in. deep at the center, are built of steel frames sheathed on the face by 3-in. planking and 1-in. tongue-and-groove rough oak lagging. They are raised and lowered around the hinges at the lower edge by two $\frac{3}{4}$ -in. wire ropes attached at the outer or downstream edge and operated by drums on shafts geared to a longitudinal shaft driven by a 75-hp. motor near the center of the group. One of the photographs shows the operating mechanism viewed from the upstream side of the power house. In this picture the gate racks are seen, and behind them the special frame supports.

One of the drawings, in connection with the cross-



PLACING POWER-HOUSE UNITS—CONCRETE BASES FOR SCROLL-CASE FORMS



CROSS-SECTION OF SPILLWAY—1:6:12 CYCLOPEAN CONCRETE FACED WITH 1:2:4 MIX

section of the power house, indicates the special framing used to support the racks designed to protect the intakes. These racks, about 42 ft. square, are designed to resist full water pressure. Instead of straight girders between the side walls there is used an arch type of framework with radiating struts to support the face beams at proper intervals and carry the thrusts to the concrete walls at each side. Two of these arch frames support each rack, and the struts are carried both laterally and in a vertical plane properly to support the facing 10-in. I-beams. These beams are of varying span lengths, increasing toward the top as the water pressure decreases.

The upper ends of these face beams are supported by

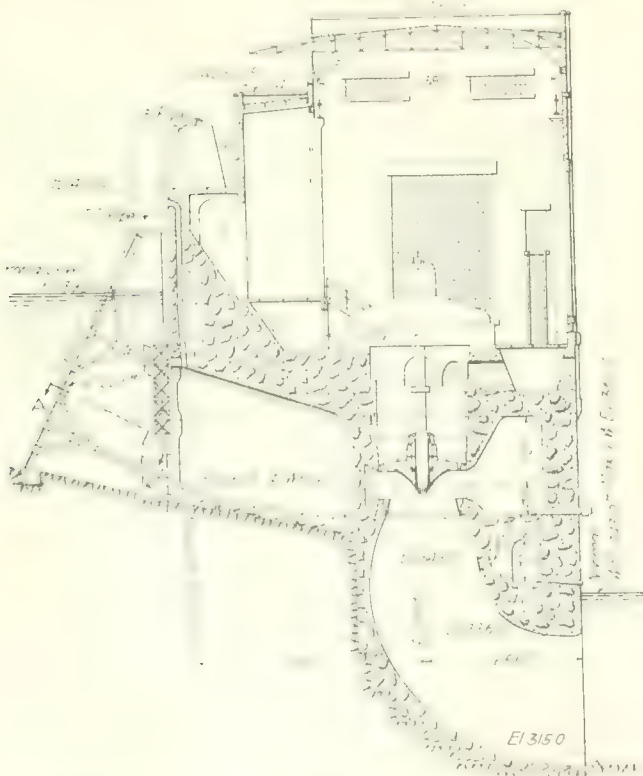
an 18-in. 55-lb. I-beam, with a bent plate to carry a timber walkway across the opening, the planks resting in a recess of the wall at the other end, as seen in the section of the power house. It is estimated that this radiating strut and arch type of support contains only about half the weight of metal required for the usual straight type of girder or beam support.

Part of the outdoor steel switching structure and transformer frame can be seen in the photograph showing the completed power house on Oct. 1. Seven 5500-kw. transformers are located in two banks of three each, with one spare, to transform the 6600-volt current as generated to 100,000 volts for transmission. Two circuits and transmission lines are provided to Great Falls and two to Salisbury, N. C.

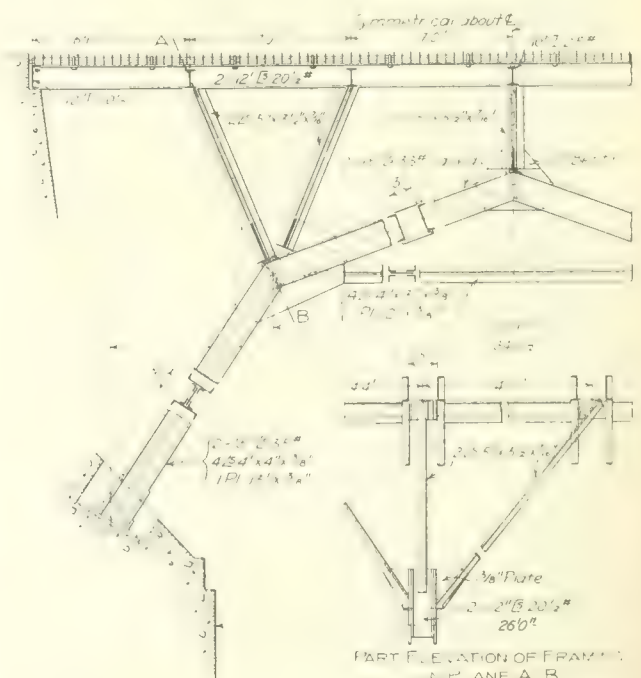
The outdoor type of transformers and switching structure was used to eliminate the necessity for expensive hous-

ing and at the same time afford a better arrangement of the switching at a lower cost than the old indoor type. Furthermore, fire risk is practically eliminated.

The contract for this work was let in May, 1915, the first turbine unit was set in January of this year, the power-house foundation was completed in June, 1916, and final closure of the dam made on Nov. 16, 1916. The contractor was the Hardaway Contracting Company, Inc., of Columbus, Ga. The turbines are from the S. Morgan Smith Company, of York, Pa., and all the electrical equipment was furnished by the General Electric Company, of Schenectady, N. Y. The design was worked out by C. A. Mees, designing engineer, and construction was under the direct supervision of A. C. Lee, assistant chief engineer of the Wateree Power Company, a subsidiary of the Southern Power Company, of Charlotte, N. C.



CROSS SECTION OF POWER HOUSE AND LOCATION OF GATE RACKS



PART SECTION AA—FRAMING FOR GATE RACK SUPPORT

Colleges Should Humanize Courses in Engineering

Nelson P. Lewis Advocates the Introduction of More Cultural Studies and Emphasizes Importance of Ability to Write

MAINTAINING that courses in our engineering schools should be liberalized by the introduction of more cultural studies, Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City, in a paper presented Dec. 28, 1916, to Section D of the American Association for the Advancement of Science at its annual convention in New York, advocated modifications in technical-school curricula whereby a major group of engineering subjects would be supplemented by a thorough course in the English language and literature, a good training in, not a smattering of, one other modern language, and courses in history, economics and the law of contracts. Mr. Lewis would follow such a program even at the expense either of eliminating some of the subjects considered to be essential in present-day engineering courses or of adding a year to college courses. Trained under such a plan, Mr. Lewis believes, graduates would reflect far greater credit upon their schools than they have done in the past. To the general subject of English and the writing of clear, concise reports Mr. Lewis often reverted. He said, in part:

IMPORTANCE OF WELL-WRITTEN REPORTS

"Engineering was formerly believed by the average citizen to be little more than a trade. The engineer's function was conceived to be the planning and carrying out of what others may have concluded to be necessary and expedient. Those who determined what was to be done seem to have felt it to be the duty of the engineer to do things when he was told, as he was told and because he was told. For a long time the engineer himself appeared to acquiesce in this conception of his functions.

"These were the conditions which prevailed within the memory of most of us, but they do not exist at the present time, except possibly in some branches of the public service, municipal, county, state and even federal. No financial concern engaged in floating bonds for private enterprises will now undertake to handle such securities until they have had a report from competent engineers as to the soundness of the project, including not only its engineering feasibility but its probable earning capacity and the market for its output, whether that be power, light or any manufactured product. Such reports, if they are to carry conviction, must not only be technically sound, but they must be orderly in arrangement, clear and concise in the presentation of facts, arguments and conclusions, and must bear upon their face evidence of the absolute confidence of the writer in the accuracy of his facts and deductions.

"Further than this, the engineer must frequently present verbal explanations and arguments to the promoters or to a board of directors before the enterprise is undertaken, as well as during its progress, if he is charged with its execution. Many reports resulting from thorough and painstaking investigation fail of

their purpose because the subject matter is not presented in an orderly manner and the conclusions are not clearly and concisely expressed. Often, too, when the engineer is called before a board of directors and asked for further information the impression which he makes is an unfavorable one, due chiefly to the use of poor English and the self-consciousness which comes from lack of practice in speaking.

THE \$30,000 MAN

"The head of a large industrial corporation, who was also the chairman of a board of trustees of an engineering school and was urging the broadening of engineering education, put the case in this way: 'We can get plenty of men who are technically competent, who are careful and thorough in their investigations, whose conclusions we know to be sound, but who cannot make a favorable impression before a board of directors. We can get plenty of lawyers who, after being coached by our engineers, can glibly and even convincingly talk to this same board of directors until some question is asked which has not been covered in the process of coaching, when they too will flounder about. If we can secure a man who possesses the conscientious thoroughness and accuracy of the engineer and also has the facility of expression and persuasiveness of the lawyer, what is a salary of \$25,000, or \$30,000, to us for such a man?'

"He therefore urged that this particular school, instead of trying to turn out a large number of \$2,000 to \$5,000 men, give to the profession a limited number of \$25,000 to \$30,000 men.

STUDIES FOR PROFESSIONAL CAREER

"What kind of studies are best calculated to fit a man for such a professional career? Let us say that the purpose of his training should be to insure: (a) Honesty and accuracy in his reasoning; (b) the habit of thoroughly testing his conclusions, in order that they may be not only the logical, but the inevitable, result of his premises; (c) clearness and simplicity in his presentation of both premises and conclusion; (d) orderly and logical arrangement of both, so that they may readily be followed by those to whom they are addressed.

"Personal honesty and high professional ideals are, of course, essential to true success in any occupation, but the course of training in these subjects should begin before a boy is born, and we are considering only his professional training after the high-school period.

"The study of mathematics should induce accuracy in thought and work. An error cannot be tolerated and will inevitably be discovered in the solution of a mathematical problem which, if properly checked, will prove itself. Such reasoning, however, is conducted through the medium of formulas and equations which are not understood by the layman, for whose benefit they must be converted into ordinary language.

"It will be futile to urge that engineering degrees should be given only as the result of a post-graduate course open exclusively to those presenting arts degrees. What we may properly insist upon is that the courses in our engineering schools be liberalized by the introduction of more cultural studies.

"It is quite probable that familiarity with the class-

ics, supplemented by a thorough course in one's own language and literature, with a fair knowledge of one other modern language, will greatly enrich one's vocabulary, but all of this is not needed to enable an engineer to write an intelligent report or to address a board of directors. It is not necessary that a report dealing with an engineering subject should be expressed in the language of a Howells or a James, nor will its force and that of its conclusions be lessened by the occasional use of a split infinitive or through the employment of a phrase that might give pain to some purists. It will, however, be much more forceful if expressed in simple but virile language, the habitual use of which can be acquired only by the reading of the best literature.

MODIFY PRESENT CURRICULA

"Why should not our engineering schools so modify their curricula as to insist upon a major group of engineering subjects, supplemented by a thorough course in the English language and literature, a good training in, not a smattering of, one other modern language, and courses in history, economics and the law of contracts? But, the technical school men will say, we would not have time to do this unless we shorten or omit some of the courses which we believe to be essential to an engineering education or add another year to our course. Then let them adopt one or the other of these courses, and it is quite probable that the records of their graduates would reflect greater credit upon these schools than they have in the past.

"It is unfair to young secondary-school graduates, it is unfair to the engineering profession, to confine their further education to strictly technical courses. Extend these courses to five years, if necessary, in order to introduce the liberal studies which have been referred to, giving credit to those who present degrees from reputable colleges, so that they may complete the strictly technical work of the curriculum in four or even three years. In other words, it is time that those who are responsible for the training of engineers realized that they are fitting men for one of the learned professions and that this cannot properly be done unless the curriculum is humanized."

Road Costs in Illinois Analyzed

A careful analysis of the cost of all Illinois state-aid roads built to date indicates that 18-ft. concrete pavements have been constructed for \$1.16 per square yard, and those 10 ft. wide at \$1.23, excluding the grading and bridges. Brick costs 60 cents more. The average excavation per mile, said B. H. Piepmeier recently in a report to the Illinois Society of Engineers, has been 4500 cu. ft., costing \$1300. For concrete culverts, 10 ft. and under in span, \$525 was paid.

Investigation of maintenance figures shows that the expense of installing transverse joints is usually sufficient to cover all maintenance expense on cracks for a period of eight to ten years, and it is further noted that there is practically no difference in the maintenance expense on a pavement that has none. Careful investigation indicates that there is a considerable reduction in longitudinal cracking of concrete pavements when the transverse joints are omitted.

Federal Road Funds Apportioned

Sum of \$10,000,000 Allotted for State-Aid Construction Work During Fiscal Year Ending June 30, 1918

THE federal appropriation for the fiscal year ending June 30, 1918, of \$10,000,000 to aid the states in the construction of rural post roads has now been apportioned among the several states by the Secretary of Agriculture in accordance with the terms of the Federal-Aid Road Act. Before making the apportionment, the Secretary, in accordance with the provisions of the act, deducted 3 per cent of the appropriation, or \$300,000, to meet the cost of administering the act. The remaining \$9,700,000, has been divided among the states as the act prescribes—one-third in the ratio of area, one-third in the ratio of population, and one-third in the ratio of mileage of rural-delivery routes and star routes. Apportioned on this basis the money is divided as follows:

APPORTIONMENT OF FEDERAL-AID ROAD FUNDS FOR YEAR ENDING JUNE 30, 1918

State	Sum apportioned
Alabama	\$208,297.80
Arizona	137,027.04
Arkansas	165,378.20
California	302,127.84
Colorado	167,380.28
Connecticut	62,180.88
Delaware	16,368.74
Florida	111,952.54
Georgia	268,658.96
Idaho	120,927.00
Illinois	441,852.46
Indiana	271,495.24
Iowa	292,351.20
Kansas	286,414.80
Kentucky	194,943.82
Louisiana	134,949.32
Maine	96,903.00
Massachusetts	88,094.44
Michigan	147,701.90
Minnesota	291,567.44
Mississippi	284,788.12
Missouri	177,811.68
Montana	339,440.82
Nebraska	196,574.38
Nevada	213,541.62
New Hampshire	128,796.60
New Jersey	41,993.24
New Mexico	118,425.36
New York	157,475.62
North Carolina	501,440.54
North Dakota	228,763.84
Ohio	152,286.12
Oklahoma	373,810.84
Oregon	230,278.00
Pennsylvania	157,374.74
Rhode Island	461,288.34
South Carolina	23,331.42
South Dakota	143,615.28
Tennessee	161,892.04
Texas	228,306.96
Utah	583,855.62
Vermont	113,900.30
Virginia	45,888.94
Washington	199,321.42
West Virginia	143,768.56
Wisconsin	106,540.92
Wyoming	256,722.14
Total	\$9,700,000.00

This is the second apportionment to be made under this act. For the fiscal year ending June 30, 1917, the appropriation was \$5,000,000. For succeeding years the appropriation is as follows:

1919	\$15,000,000
1920	20,000,000
1921	25,000,000

These sums do not include the \$1,000,000 which is appropriated each year for ten years for the development of roads and trails within or partly within the national forests.

Chicago's Half-Completed Garbage-Reduction Plant Turns Expense Into Income

Col. H. A. Allen Tells of New Control Unit, a Five-Yard Box, and of Offense Elimination by Non-Carbonization and "Petticoat" Stack Diffusers

EXPENSE has been turned into a substantial income at the Chicago garbage-reduction plant, and at the same time the operations are carried on without offense. Many new ideas have been worked out by the technical staff of the city; and although it has been expensive to rebuild a new plant on the restricted area and to keep the old plant working inoffensively, the unit costs per ton have steadily decreased each year since the city acquired the plant in 1914, and this year a profit of 87 cents per ton is expected. Some of the more interesting engineering features—such as the design of a new collection box, the new "petticoat" stack for commingling the drier gases quickly with the air, the concrete cyclones, and the difficulties encountered in building a new plant on top of an old one—were described Jan. 19 by Col. H. A. Allen, consulting engineer for the city of Chicago and chief of waste-disposal technical staff, before the Chicago chapter of the American Society of Mechanical Engineers. From this paper the following extracts are taken:

During the bad weather of February, 1914, instructions were issued to start the work of rehabilitating the old plant purchased from the Chicago Reduction Company. This necessitated working night and day on the design and construction, both being carried on at the same time. By June the plant began to handle all the garbage of the city in a practically inoffensive manner.

One of the greatest difficulties in disposal problems is the location of loading stations and plants; or, more strictly, the securing of permission for sites. While

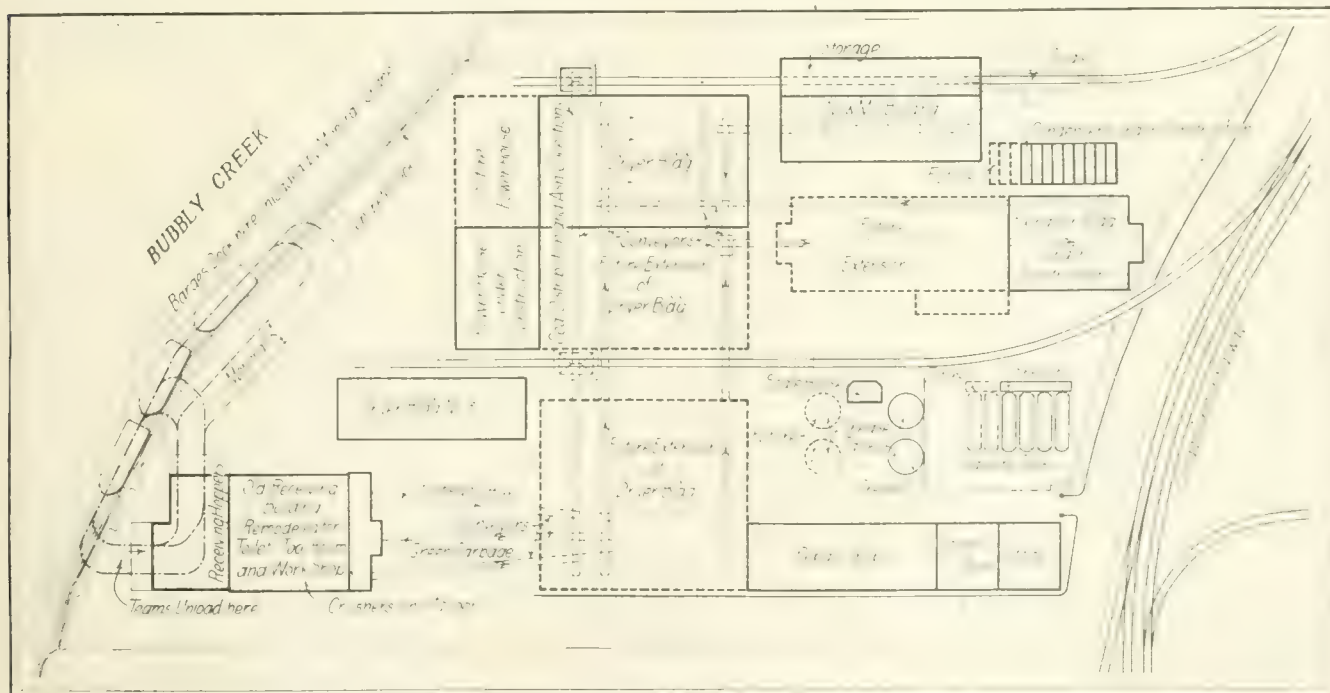
the citizens appreciate the necessity for disposal plants, they prefer to have them near their neighbors' rather than their own backyards. Hence, locations are too often acquired by political expediency rather than by good engineering judgment.

The women of Chicago, through their various organizations, have played a most important part in bringing about the solution of the city's waste question, especially as regards garbage. These organizations are of invaluable assistance in educating the householders properly to separate and take care of household wastes.

The city of Chicago approached the question in a broad-minded and business-like way, appropriating requisite funds for investigations, studies and experiments.

COLLECTION UNIT SELECTED

To facilitate this work all along the line, from the production of waste to the point of final disposal, a unit was selected. The most difficult phase of the entire problem is getting the garbage from the kitchen to the collecting unit. It was for this reason that the garbage box was selected. The larger the capacity of this unit, other things being equal, the less the cost of collecting and handling. Study showed that a 6-cu. yd. box when filled became too heavy for a two-horse team except on the best of paved streets. As only 13 per cent of the alleys in Chicago and 62 per cent of the streets are paved, this prohibited such a large unit being used throughout the city. The 5-yd. unit adopted consists of a box 12 ft. long, 4 ft. wide and 32



CHICAGO MUNICIPAL REDUCTION PLANT AS IT WILL BE WHEN ALL NEW STRUCTURES ARE BUILT

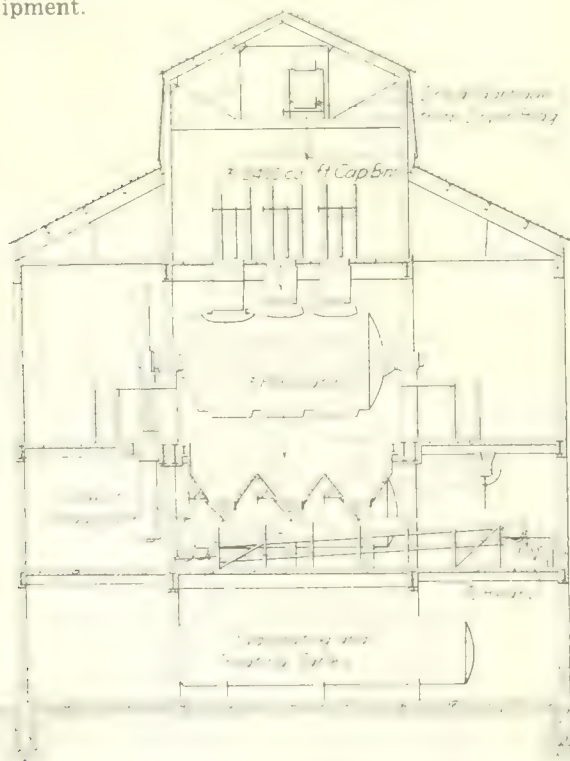
in. high, as shown in one of the illustrations. Two such boxes can be loaded abreast, three in length and two vertically, making twelve boxes per specially designed railway car. One-half of this number can be loaded on a specially designed street car. The net load of garbage contained will be approximately 34 and 17 tons respectively.

By adopting a standard collecting unit it is possible at loading and disposal stations to standardize hoisting equipment, including cranes, runways and slings; hauling equipment, including wagons and tractors; and transporting equipment, including railways and electric cars, steam and tow barges.

The studies so far conducted indicate that the following may be considered an axiom: That system of handling an offensive substance is the most sanitary, least offensive and, in general, commercially the best which exposes the least or fewest surfaces to contact with such substance.

DRIER PROCESS SELECTED

In the drier process of reduction in use at the Chicago plant the garbage is generally first run through a crusher to smash open cans of condemned foodstuffs and to break up other large material for more efficient drying. The material from the crusher is then fed into driers, its moisture content being reduced to 10 per cent or less. From the driers it is fed into percolators, where it is subjected to the action of a grease solvent. The grease-saturated solvent is drawn off, the solvent distilled off and condensed for repeated use, the grease being treated and stored for shipment. Steam is then turned on to drive off any residual solvent, after which the tankage, containing about 26 per cent moisture, is withdrawn and put through final driers to reduce the moisture content to from 6 to 8 per cent. It is then screened, milled and screened, and stored ready for shipment.



EXTRACTORS HAD TO BE BUILT UP INTO THE AIR TO CONSERVE SPACE



SMOOTHLY FINISHED CONCRETE CYCLONES HAVE GLASS PEEK HOLES

This system was one of the first employed, but in most cases has been replaced by the cooking process, or the latest modification of it, the Cobwell system. Colonel Allen's investigation convinced him that one great cause for offense at the plant of the Chicago Reduction Company was due to the use of direct-heat driers and consequent burning or carbonizing of certain greases and materials, such as hair and flesh. It would seem that certain offensive gases so formed are not soluble in water and therefore are not readily washed or scrubbed. This scorching action, he holds, was not only the cause of offense but also the cause of loss in the amount and value of byproducts. The result was the installation of the more costly direct-indirect heat driers.

As predicted, when using the indirect-heat driers not only has the necessity for scrubbing practically been eliminated, but the tankage and grease are better and have a higher commercial value. The garbage is dried from 75 per cent moisture to 10 per cent or less in one cylinder.

EACH DRIER HAS "PETTICOAT" STACK

The principal aim in designing this plant was to eliminate offense. It was thought advisable, therefore, to provide each drier with a "petticoat" stack consisting of a series of concentrically placed steel cylinders, each one larger than the preceding lower one. This stack permits commingling of outside air with the escape gases from the drier, thereby cooling and throwing down a certain amount of moisture which carries with it considerable fine suspended matter. In addition it causes dilution. The stacks are provided with suitable sprays for use in case of any possible emergency due to delayed collection in hot weather, accidental fire or overloading. Each drier is arranged in the newly designed drier building as a

practically complete unit, having its own cyclone and "pettioat" stack.

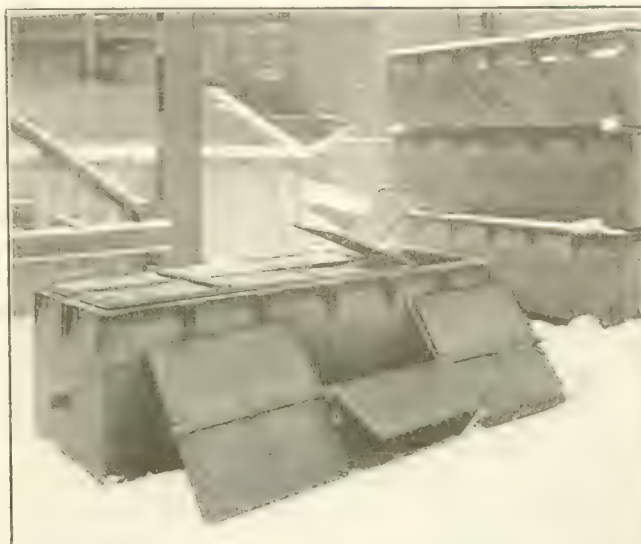
The cyclones are made of reinforced concrete, about 3 in. thick, with the bars in the cone hooked over a circular beam at the junction with the cylindrical portion. An extremely smooth, plastered surface was obtained by treating the surface with a scratch coat and finishing smooth with a rich mix cement mortar.

PROFIT EXPECTED THIS YEAR

The net costs of the disposal of garbage to the city since the old plant was acquired average 48.2 cents per ton. In 1914 the cost was 76.8 cents; in 1915, 63.2 cents, and in 1916, 16.1 cents. The estimated profit in 1917 will be 86.9 cents, when it is expected 145,000 tons will be handled. The cost of handling will amount to \$477,000, but will produce a revenue of \$603,000. In this estimate the price of grease has been taken at 5 cents per pound and tankage at \$5 per ton, both figures much below present market prices. During 1916 the extractor plant operated only from June on and the mill house was not in full operation until the latter part of the same month.

From Jan. 1 to the time of starting the extractor plant the city received only \$3.27 a ton for commercially dried garbage, which is green garbage dried down to 10 per cent moisture. The capacity of the old mill house was not sufficient to handle all garbage degreased, necessitating the storage of approximately 14,000 tons on the property north of the plant, thereby greatly increasing the cost of production of tankage.

Colonel Allen estimates the amount of garbage that will be delivered to the plant during the year 1917 at not less than 150,000 tons, from which should be obtained not less than 2000 tons of grease and 30,000 tons of tankage. The city of Chicago at present has a

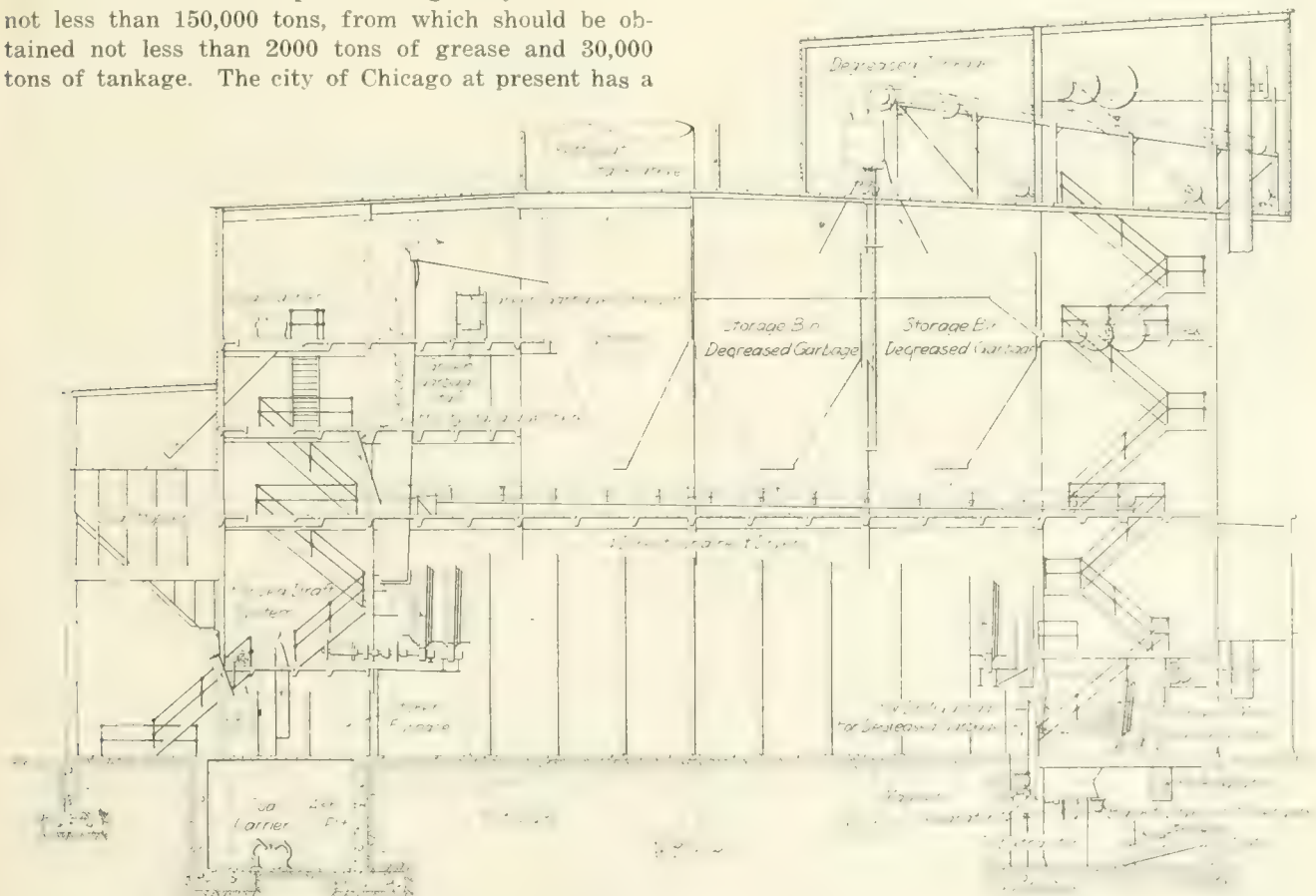


NEW COLLECTION UNITS WILL STACK ON BARGES OR CARS

The eight-section cover in place is the one chosen. The stiffened sides eliminate obstructing cross-braces. The rectangular trunnion, grasped by a motor-actuated chain hanger at disposal plant permits a controlled rotation of the box.

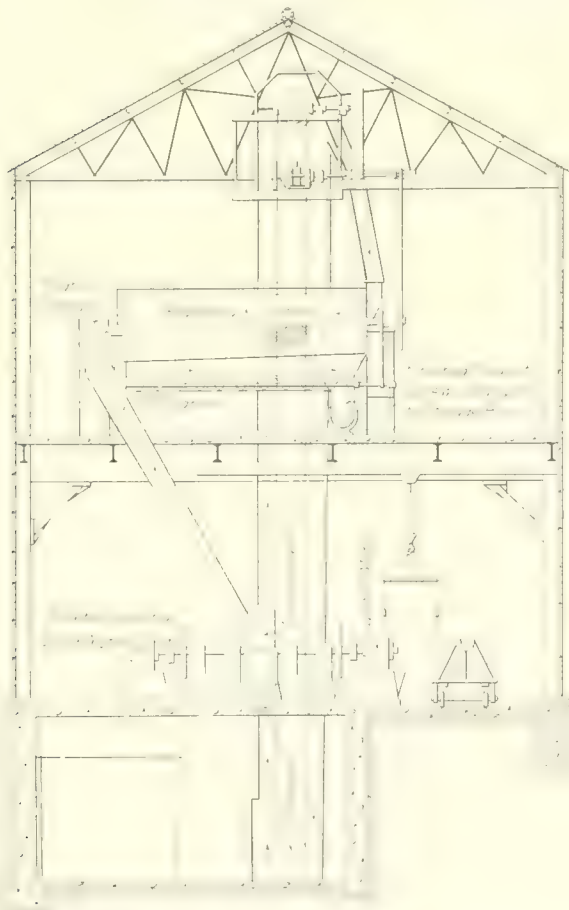
contract for the purchase of garbage grease at a price of 7.29 cents per pound on a basis of 3 per cent unsaponifiable, total impurities not to exceed 6 per cent. The city has a contract for the purchase of garbage tankage at the sum of \$4.16 per ton. The price received for the grease is high, but that received for the tankage is low, the present market value of garbage tankage exceeding \$7 per ton.

Garbage comes to the plant by barges on Bubbly



LONGITUDINAL SECTION OF NEW DRIER HOUSE

Creek, an arm of the Chicago River, and by team, the boxes from both being unloaded by a monorail crane in use now for more than a year. In winter the boxes are dropped for a few minutes into a thaw tank of boiling water kept hot by steam coils. Designs for new steel barges include arrangements to heat the boxes en route with exhaust steam. Had a new site been available a plan would have been worked out whereby the boxes could be dumped directly into the driers, thus saving handling; but the old plant, with its receiving hoppers, crushers and button conveyors to the driers, had to be maintained while construction went ahead. As operated now the green garbage goes first to old drier house 1, where are located six American Process Company



TWO-STORY MILL HOUSE HAS SIMPLE LAYOUT

oil-burning driers, which reduce the moisture from 70 or 80 per cent down to 30 per cent. A portion of the green garbage, however, goes to drier house 3, where two newly installed Atlas indirect coal-burning driers reduce the moisture at once to 10 per cent. The first portion mentioned goes from No. 1 to drier house 2 to be reduced to 10 per cent through two old direct-indirect oil-burning driers. The 10 per cent material from Nos. 2 and 3 then goes to the old extractor plant for degreasing. About 20 per cent of moisture is added here in the steaming process in the seven tanks. As the new mill house has been completed, the degreased tankage goes to it after having the rags removed, and another drying to 10 per cent takes place in the old apparatus. Within a few months new drier house 4 will be completed and the green garbage will go direct from the button conveyors to it, thence to the new percolator

house, back again to No. 4 to be redried, then to the new mill building.

NEW DRIERS DIRECT-INDIRECT TYPE

The four new 100-ton Atlas driers are of the direct-indirect type, heated to low temperatures, so as not to scorch the material, by coal furnaces equipped with automatic stokers. Exhaust fans pull the moist air to the fourth floor and discharge it into the cyclones. On this floor are located the green garbage conveyors which dump into bins on the third floor, providing a small storage for short delays. From here the garbage is hoed by hand down a chute into the mouth of the drier. At the far end is located a rotary screen to remove rags, cans and large material to a picking table. Banana stalks, grape fruit and other large objects are carried back to be crushed and returned to the drier. The material passing the 1 $\frac{1}{8}$ -in. mesh screen goes to the percolators, from where it is returned to be stored until sent again through one of the four Atlas driers.

Provision is made frequently to break the continuity of the material so that a fire cannot train back any distance. The driers are equipped with sprinklers should the contents be fired, and provision is made for returning the material again to the mouth of the driers.

DUST A MINIMUM IN MILL BUILDING

When passed through the driers the second time the tankage goes to the mill house. The disintegrators are driven by 40-hp. motors, right and left-hand drive being connected at either end, thus eliminating belting. As the disintegrator machinery must be replaced often, a special mounted cage and crane are provided. After screening, the tankage is sent by screw conveyors to the stack houses located over the shipping track. The oversize, with the fluffy material eliminated, is returned to the mills.

An intricate vacuum system reduces the dust nuisance in the grinding room to a minimum. A mechanical device in the suction on the filters lets the pressure off and on for stated periods while the filters are agitated. All motors are inclosed, and a vacuum constantly removes dust from the rotating parts.

The appearance of the extension of the new buildings, which are of steel-frame construction, with walls of plastered metal lath, metal sash and roofs of Federal cement tile, has been given special attention, with the idea of reducing any actual or imaginary odium attached to such a plant. The street end of the extractor building is made ornamental with a pressed-brick tower, serving the double purpose of a fire wall and an outside concrete stairway to the street.

Fire Hose to Clean Sewer Pipes

The city of Brawley, Cal., is effectively using a home-made nozzle on a 2 $\frac{1}{2}$ -in. fire hose for cleaning out small sewer lines, according to G. R. Wade, city engineer. The nozzle consists of a fire-plug cap perforated with seven or eight $\frac{3}{8}$ -in. holes and attached to the end of the hose. A pressure of about 50 lb. keeps the hose stiff enough so the nozzle can be pushed ahead from manhole to manhole. The amount of water escaping through the perforations is sufficient to clean out the silt which has heretofore frequently given trouble.

Organized Labor and Business Must Accept Equal Obligations

Inevitable Conflict Must Be Met So as to Conserve the Interest of the Public, Says Harry A. Wheeler

THAT organized labor has now reached a point of national accountability and that it must be controlled by the same laws which are applied to the regulation of organized business was the contention of Harry A. Wheeler, in an address delivered Feb. 1 before the fifth annual convention of the Chamber of Commerce of the United States at Washington, D. C. His subject was "Industrial Relations" and his remarks are given below:

"I do not hope that you will agree with all of my statements, and I am certain that the labor group will not approve. Nevertheless as I may be able I shall hold up to you certain conditions with language as naked as I know how. My purpose is to speak not in defense of organized business or in condemnation of organized labor, but rather to interpret by an honest analysis of the situation why the great neutral public touched neither by the indignities put upon business by certain groups of organized labor nor by a sympathy with labor in its sometimes real, but often imaginary, grievances against organized business will not countenance any return to 'strong-arm' methods, but will insist upon the recognition of mutual rights and that the contest shall hereafter be carried on with full realization on both sides of the rights of the third and neutral party.

CAPITAL AND LABOR

"Reviewing the conditions which now confront us as a nation, arising from abnormal industrial activity, fictitious prices, false values and reckless extravagance, and looking forward to the conditions which will obtain when the world resumes its domestic tranquillity is the relationship which shall exist between capital and labor and which we are accustomed to call our labor problem.

"If a serious and unprejudiced study of the subject is undertaken, we are faced with such a wealth of argument from both sides, each giving evidence of deep sincerity and supported by illustrations so appealing that the mind becomes confused with the mingled and contradictory proof and logic, that we feel inclined to cast aside all of the arguments and to endeavor to hold the subject up, not for complex scientific analysis, but rather that the simple sense of right and justice may be applied to this most complicated relationship of our economic existence. Unless we do this we are sure to find that we are chasing the scientific solution to the utter forgetfulness of the human elements which neither law nor regulation nor force can harmonize.

A CONDITION, NOT A PROBLEM

"First, then, that which we call a problem is not at all a problem, but a condition. If it were a problem we might hope by applying the science of law or of economics to find a solution. Or if this relationship could be reduced to a matter of conduct, controlling laws or regulations or customs could be evolved and commonly accepted, as in all of our other social relation-

ships. It is a condition because it is a contest between two groups of human beings charged with responsibilities which conflict, surrounded by influences which develop opposite mental conditions and with points of view difficult indeed to focus upon a point of common interest.

"It is a meeting point of two living forces, the one having the purpose to hold, the other to get; a contest which began with the birth of the race and which will continue to the millennium.

"The second point is closely related to the first, namely, that there will not be, and we should not expect, a complete adjustment between these two forces, capital and labor, whereby co-operation will replace the periodical struggles for advantage.

"Julius Henry Cohen of New York in a recent article on the revised protocol in the dress and waist industry so well expressed the point which I have in mind that I wish to use his words:

"There seems to be a rather current belief that there is presented to employers to-day a clear choice between peace and war. This is a fundamental error made by nearly all critics of the protocol. The fact is that as long as we live and for a longer period still we shall have conflict in industry. We shall not have peace. The real choice is not between peace and war, but between conflict and conflict. Or, put it another way: the question is, how shall inevitable conflict be met so as to conserve the best interests of all parties concerned?"

BUSINESS LEADS THE WAY

"My third point is this: Since the differences which enter into our industrial relations are fundamentally human, and since the conflict is destined to continue, it is logical that it will be carried on by both sides with increasingly efficient organized forces. Business has led the way in teaching the advantages of organization as it has in every other development in our industrial and social life. The old time units of production and distribution which the individual owned and controlled united with other similar units in the partnership. These later took the form of corporations in order that there might be greater freedom from individual liability and less interruption of operations when changes in interests became necessary or desirable. Corporations linked themselves into combinations for economic advantage. Lines of business organized into local, national and trade groups. The business and professional interests of whole cities joined hands for the commercial and civic advantage of united action and finally all of these united in this organization under whose auspices we are now meeting, yet no one will be bold enough to declare that, from first to last, any of these organizations had for their primary purpose or for their purpose at all the betterment of the other group to this discussion.

BENEFITS OF ORGANIZATION

"What benefits have been secured as a result of organizing business? We all know in our own city the answer to this question and will bear witness that the multiplied forms of organization have not only been the result of necessity but have brought safety, efficiency and harmony out of danger and waste and senseless

warfare. What wonder that having the example furnished by organized business this other group should do likewise? The only wonder is that the organization of this group should not have been more rapid.

"In 1910 of the estimated 27,000,000 wage-earners only 8 per cent of the whole were members of labor organizations. Or if deductions are made of all occupations which do not readily lend themselves to organization, the percentage would be 18.4 per cent of the potential possibilities. In 1910 trade unions had 2,116,317 members; in 1914, 2,674,000 members; and to-day probably close to 3,000,000, or 10 per cent of all wage-earners and more than 20 per cent of the potential possibilities. The value of organization in the field of labor is as obvious to labor interests as in the group of organized business and as in the case of organized business the primary purpose is only to serve its own interest.

DAY OF ORGANIZED FORCES

"The point is that we are living in a day of organized forces. Individualism has been relegated to the rear. We think and act through the group, and organization in the field of labor will move forward with rapidity in times like the present and with slight loss in times of depression but with the certainty that each decade will witness a marked increase in the number of trades or vocations organized and with a larger per cent of each trade in the union ranks.

"My fourth point is: If we concede that we are confronted by a condition of natural opposites; if the conflict must continue, and if it is to be directed by organized forces of increasing strength, then in the interest of national safety these forces must come under some measure of control, for while the law may be powerless to harmonize conflicting human relationships, it can and must control the operations of known forces that, if allowed to continue without restraint, will trespass upon public rights and affect the public welfare.

REGULATORY LEGISLATION

"Organized business has sown its wild oats and has been chastised by the legislative rod. If it shall henceforth hold itself in check against a return of its own shortcomings; if it shall honestly endeavor to live with contending forces, rather than attempt ruthlessly to destroy them, then it will become the basis of a new governmental program and of a new economic life.

"Organized labor is passing through comparable stages. Its program is more simple than that of organized business and lends itself to greater unity of action. Its purpose is wholly selfish. To achieve its aim it gives no consideration to the effect of its acts upon public convenience or public welfare. Its program is better wages, shorter hours, better working conditions. The program suits as well the laborers on the Pacific Coast as on the Atlantic and comprehends the desires alike of laborers in the lumber camps of the West, of the cotton mills of the South and the steel mills of the East. Its driving force is votes; its goal, exemption from interference by law or regulation with any act which may advance its program. Its purposes are gained by force or threat of force, and in the exercise of that force some of its units have sinned grievously against society and most of its units, when in action,

have committed acts for which the law would severely punish the private individual. Its weapon—the strike—may not be denied it when the effect is only upon an employer or group of employers in the same business or upon a very limited portion of the public, but organized labor has shown itself not content to halt its combination of units with the trade or community, and as in the railroad situation last summer, and later in the traction strike in New York, both supported by frank expressions of approval from the American Federation, its purpose was to extend the area of its activity to nation-wide limits if necessary. Surely as this policy is continued the public will rise and demand protection against such an abuse of power and such utter disregard of the rights of society.

LABOR DISREGARDS PUBLIC WELFARE

"Organized labor has not yet seen a vision of its responsibilities to the public; it has not yet felt the weight of the legislative rod, but it is destined to encounter both public and legislative correction for any persistent exhibition of arrogance, ignorance or brutality of which it may be guilty and it may be that such correction and restraint must be administered before answer is to be made to Julius Henry Cohen's question: 'How shall inevitable conflict be met so as to conserve the best interests of all parties concerned?'

"Why is it that in the consideration of these two organized forces a clear legislative distinction is drawn between them in their relation to government and their accountability to society? Some of you may answer that it is because the individual element in the membership of one of them, with its supposed powers of swift and certain retaliation, has been more considered than the acts of the organized force itself. I am not willing to contend that this is not a factor of more than ordinary importance, but I should prefer to find another reason and to set it up for consideration even though it be less logical. It is this: Until recently the force of organized labor has not come to the point of national action and therefore of national accountability whereby a continuance of present exemptions in the face of a power to inflict national harm would constitute a monumental blunder. When organized forces, no matter how composed, become equal in the sphere of their activities, in their numerical strength and in their power to inflict injury, they must be controlled by the same laws and must share alike in the obligation to uphold the rights of all.

"At the outset I stated that I did not know that I should bring you a single final conclusion but it would seem that my conclusions are ready made for statement. In our industrial relations we are dealing with human nature, which we cannot change by force or by law. Conflict will persist because mental attitude and point of view cannot be adjusted to our present theory of co-operation. Highly organized forces are an economic necessity in the field of business, and organization which is permitted and encouraged in the field of business may not be denied or discouraged in the field of labor. Even the right to use the strike as the most potent weapon of organized labor must be acknowledged until that right encroaches upon the safety of the nation and the welfare of its people.

"Here a new national policy must be developed to

which all organized force of whatever antecedents shall alike submit itself. In organized business legislative restraint and regulation has been applied rather harshly and often complaint has been justly made that its effect has been to retard development and to place us as a nation in an unfavorable competitive position. To-day the principle of regulation and restraint is recognized and accepted by organized business, and with the coming of the tendency honestly and earnestly to co-operate with the regulatory machinery of the government may slowly come public consent to modify the sweeping inhibitions of the law and permit larger co-operative action so long as a general welfare clause is consistently upheld and rigidly obeyed.

"In organized labor action heretofore has been within the trade or community or limited geographical area, but never nationally. Hence the necessity for national regulation has not been imperative. During 1916, however, organized labor laid bare its ultimate program. Four of its units or divisions made common cause to tie up the nation's transportation and thus paralyze every industrial operation. Although this act would have adversely affected other divisions or units of organized labor, protest was feeble, and by common consent all units not immediately involved stood by to watch the struggle. The result of this struggle is still a painful subject to this chamber, but it graduated organized labor into a force capable of nation-wide action and, therefore, placed it beyond the right to claim exemption from restraint. It also proved the un wisdom of Section 6 of the Clayton Law, under which in the face of a national conspiracy to inflict irreparable harm upon an entire people, no legal restraints were found available.

"This brings me to my last conclusion, namely, that the public interest as a third and now expressible interest in industrial disputes was born last summer and will hereafter demand its rightful voice in every national controversy. If the sanction, if the judgment of society, was for a shorter working day, how much more real is that sanction in the course of compelling public inquiry before action be taken interrupting the public service?

"I have tried nakedly and without bias to set forth

the conditions with which we are confronted, as I see them. Never do I reach this point in the consideration of this subject that my mind does not fly back to Walt Whitman's words in urging affection as a cure for social ills: 'Were you looking to be held together by lawyers? Or by an agreement on a paper? Or by arms? Nay, nor the world nor any living thing will so cohere.' And it is so in the field of our industrial relations. Laws and agreements and arms may compel submission but will never win co-operation. And only as these two great economic forces of organized business and labor may come to accept the same measure of responsibility toward public welfare and to deal with each other not craftily but in a spirit of wholesome honesty and respect shall we approach the fount where 'inevitable conflict shall be met so as to conserve the best interests of all parties concerned.'"

"Double-Header" Motor-Truck Train Operates Across Desert

Trailers Used Between Motor Trucks in Handling Heavy Loads Over Bad Roads on 130-Mile Route in Oregon

A TRUCK-TRANSPORTATION company was recently organized for the purpose of hauling supplies from Bend across the desert to Paisley, Ore. The distance between the two terminals is 130 miles, chiefly through the desert, and part of the way over narrow, rough road with numerous 15-per cent grades, one of which is 2 miles long. An account of the truck problems recently appeared in the *Standard Oil Bulletin*.

Regular trips were made, hauling 3 tons to the truck and 2½ tons on a trailer, covering the distance between terminals in two days. On one occasion it was necessary to take in a 12-ton boiler. This was loaded on the two trailers, as shown in the photograph. These were coupled up with one truck ahead and one truck behind. The trucks themselves were each loaded to capacity, making the total freight on this trip approximately 16 tons. The trip was made without difficulty of any kind and on regular schedule time.



TWELVE-TON BOILER COUPLED BETWEEN MOTOR TRUCKS OPERATING OVER DESERT ROUTE

Advocates American Society Bureau for Engineering Services

P. M. Churchill, in Presenting Resolution Before Annual Meeting of Am. Soc. C. E., Gives Arguments in Favor of Radical Move

ONE of the most radical forward steps in the history of the activities of the American Society of Civil Engineers was advocated by P. M. Churchill, U. S. assistant engineer, Topeka, Kan., who offered a resolution at the annual meeting that a committee of three should be appointed to co-operate with other national engineering societies to formulate a plan for the systematic marketing of engineering services. The resolution, which on motion was referred to the board of direction for action, provided that the committee be empowered "to employ a competent, progressive engineer, if deemed advisable, to work out the details of such a plan." Mr. Churchill's letter, which was read by the secretary at the meeting, contains interesting criticism of the report by the committee on compensation of engineers (see Engineering Record of Jan. 13, page 68). This committee was appointed several years ago, following a motion by Mr. Churchill, who, in his letter, from which the following extracts are taken, presents arguments in favor of the plan:

COMMITTEE FAILS TO REPORT CONDITIONS

"I noticed in their report the committee says that it has never been able to determine what was intended by the portion of the motion referring to the 'condition of employment.' By this I intended that the proportion of lost time which the conditions of engineering work force on most engineers should be stated with the compensation received, in order that the real net income of engineers might be determined; furthermore, whether or not living expenses are allowed, travel expenses reporting to and returning from a piece of work were received, and other items which cut down the actual net receipts which finally decide the scale of living. I fully realize the difficulties in the way of obtaining this information, and it is partly for that reason that I have, in the motion just presented to you, provided for the employment of an engineer actually to handle the details of the work.

ENGINEER SHOULD BE BUSINESS MAN

"The engineer of to-day is or should be a business man, for otherwise a very large part of his technical skill will be useless simply because it will not materialize. But engineers have been slow to realize this and have often justified the criticism of their clients that they were all right for theory, but if you wanted anything accomplished you must get a business man to take charge of it. This opinion of the engineer has placed lawyers and merchants, and in fact every other kind of a man but an engineer, on the large commissions dealing exclusively with engineering work. The New York commissions and the former directors of the Port of Boston are sufficient examples of this. It is common to hear the appointing power say, 'We can hire plenty of engineers for the technical part, but we must have a business man to decide the policies of this commission.' We engineers individually can do little

to counteract such tendencies, but the large national societies are in a position to secure a hearing when they speak, and so far that voice has been very feeble.

TO ORGANIZE ENGINEERING POWER

"In its larger features the motion I have just proposed is intended to organize the power of the great national societies, to make effective the large work of the engineering profession and to prevent its being crippled through the appointment of ignorant men to positions of power over engineering work. It is to provide machinery whereby the organized opinion of the engineering profession expressed through its national societies may quickly make itself felt when, for instance, a governor attempts to appoint on a commission having control of large engineering work politicians, lawyers, merchants, blacksmiths, etc.

"In its smaller features this motion intends to provide for working out the details of an engineering exchange where engineers may register their qualifications, file their credentials, and thereafter have the society furnish prospective employers with certified copies of these credentials, thus doing away with the present inadequate system of references which requires a new letter from former employers every time an engineer seeks a new job. It furthermore means that the agents of the society would watch the market and when it is learned that a community intends some development like a city waterworks it would inform the city authorities of the class of engineer required properly and economically to handle such work, of the salary necessary to secure a properly equipped man, and, if desired, would furnish a list of several such men who were available.

BARBERS AND WAITERS ELECTED COUNTY ENGINEERS

"Engineers requiring a force of men would have a reliable source from which to draw, which is not the case at present. It would prevent waste which now occurs in county work all over the country through ignorant supervision. I know of one county in one of the Middle States whose road and bridge work yearly amounts to several hundred thousand dollars, where in succession a barber and a waiter from a cheap restaurant have been elected county engineers, responsible for the design and construction of these works. These men after finishing their term of office have set up as consulting engineers and still further wasted the money of that community. This record can be duplicated all over the country, and the national engineering societies are directly responsible for the continuation of this condition.

"We are all familiar with these conditions. Most of us would like to see them remedied. We can only remedy them by concerted action, and such action should come from national societies."

Where Is the Money Coming From?

The revenue available for road purposes increased from \$37.01 per mile in 1904 to \$98.22 per mile in 1914—an increase of 165 per cent; while the actual financial burden upon the taxpayer increased in the same period from 23 cents to 35 cents per \$100 assessed value, an increase of only 52 per cent.

Simple and Cantilever K-Trusses Analyzed

Part I—Formulas Derived and Influence Lines Drawn for Chord and Web Stresses and Applied to the Determination of Maximum Stresses

By C. L. WARWICK

Instructor in Civil Engineering, University of Pennsylvania, Philadelphia

THE essential feature of the K type of truss is the use of two main diagonal web members in each panel, arranged in such a way that the stresses are statically determinate. The consequent division of the shear results in lower sectional areas and less complicated details of web members and their connections than obtain, for example, in the Pratt truss with sub-panels; while it has the advantage over other types with two main diagonals in one panel, such as the double-intersection Warren truss, of being statically determinate. In view of these and other advantages, such as comparative freedom from secondary stresses and adaptability to economical and rapid erection, it may confidently be assumed that the K-truss will command wide attention among designers, especially for long spans, to which it is peculiarly adapted. The advantages of the K-truss and the reasons for its use in the Quebec Bridge are fully explained in a paper by Ralph Modjeski on "Design of Large Bridges, with Special Reference to Quebec Bridge" in the Engineering Record of Sept. 20, 1913, page 321.

ANALYSIS FOR PRIMARY STRESSES—ASSUMPTIONS

In the analysis which follows, the endeavor has been not only to develop direct, concise methods of determining the so-called "primary" stresses, but to emphasize those features which differ from the analyses of the usual types of trusses given in text-books on framed structures. Influence lines for stress are constructed, since these show most clearly the relation between stress and position of load and are very useful in discussing maximum stresses. The truss is first considered to act as a simple span, and the methods developed are then applied to a cantilever arm. These methods, however, are independent of end conditions and may be applied, for example, to a continuous girder after the reactions have been determined. As usual in problems dealing with influence lines, the stresses are computed for a single concentrated load of unit intensity moving over the structure.

The truss illustrated in Fig. 1 is similar to the anchor and cantilever arms of the Quebec Bridge. Although a truss acting only as a simple span would be symmetrical about its center line, it is convenient to use the same truss for both simple span and cantilever arm. Moreover, the anchor arm acts as a simple span under its own weight and loading. The following assumptions have been made in the interest of a general treatment:

1. That the points c' , e' , g' , etc., do not lie in the same straight line (in the Quebec Bridge they are in a line parallel to the grade line);
2. That such members as $c'E$, $d'e'$ and $e'G$ are not parallel;
3. That the panels, and their divisions into sub-panels, are unequal in length; and finally,
4. That the slopes of the chords are unequal.

The analysis will be confined to the chord and web

members in the panel EG, these being typical of the entire truss. The notation required is shown in Fig. 1. The values of OO_1 , OO_2 , and O_1O_2 are self-evident. The solution for z , the perpendicular distance from O_1 to $e'G$, is given in Fig. 1 (a). The value of z_1 follows by analogy.

Top-Chord Stress EG—Imagine the truss to be divided into two parts by section 1-1, Fig. 1, cutting five members, and forces to be applied at the ends of these members equal to the stresses in them before the truss was severed. These stresses and the external forces to either side of the section form a system of co-planar forces in equilibrium, and the algebraic sum of their moments about any point in their plane is therefore equal to zero. To find stress EG, moments should be taken about e , since three of the other four stresses, Ee' , $e'e$ and eg , traverse e and are thus eliminated from the equation of moments. The fourth stress, $d'e'$, is evidently zero except when there is a floorbeam concentration at d' —that is, for loads in panel CE. The determination of stress EG may therefore conveniently be divided into two parts—(1) for loads outside of panel CE, in which case EG is the only stress in the moment equation, and (2) for loads in panel CE, in which case stress $d'e'$ enters that equation and must therefore be determined.

The first part presents a problem similar to that of the simple Pratt truss. Thus, with the unit load in any position from e' to the right, at a distance x from the right support, the only external force to the left of section 1-1 is the reaction, R_a at a . Since stress $d'e'$ is zero, the algebraic sum of the moments about e of R_a and stress EG must equal zero. It will be more convenient to solve for the horizontal component, from which the stress itself may readily be found by multiplying by P'/P . Therefore resolve stress EG into vertical and horizontal components at E ; the vertical component has no moment about e ; the lever arm of the horizontal component is h . Then for loads from e' to the right,

$$R_a \times r - \text{horizontal component EG} \times h = 0,$$

$$\text{or since } R_a = \frac{x}{l}$$

$$\text{horizontal component EG} = \frac{x}{l} \times \frac{r}{h} \quad (1)$$

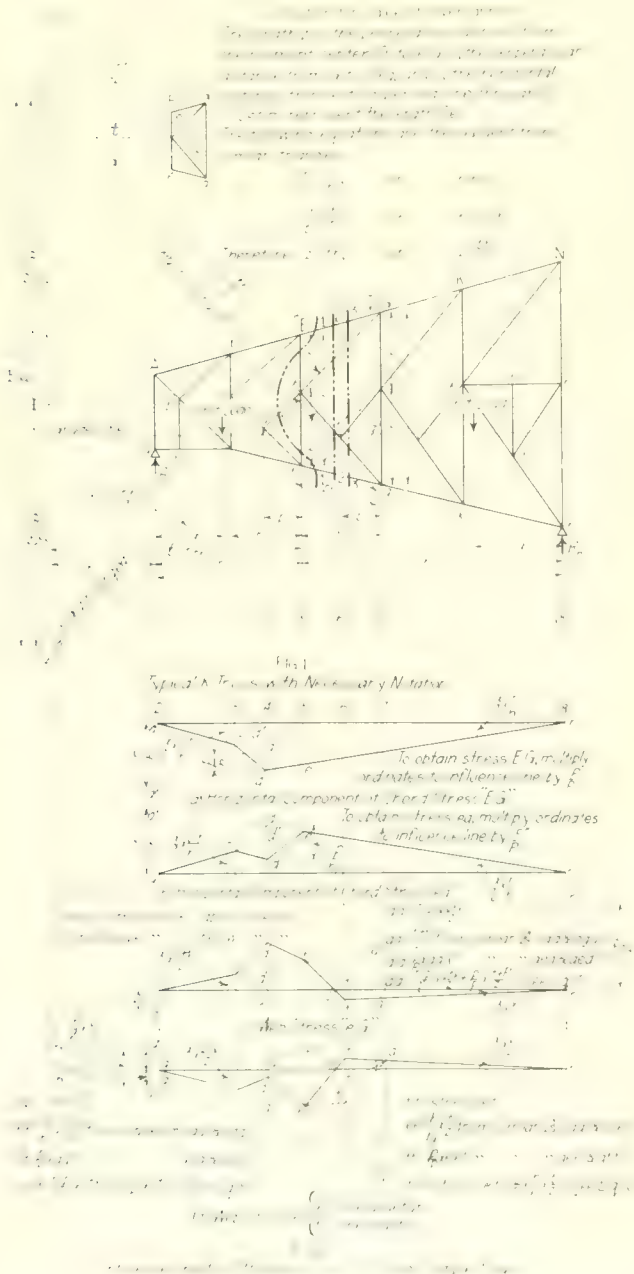
In equation 1, x may have any value from zero to $l - r$. Stress EG is compressive, opposing the moment of R_a about e .

Similarly, by placing the unit load in any position from c' to the left, at a distance x' from the left support, and taking moments about e of the forces to the right of section 1-1, the following equation is obtained:

$$\text{horizontal component EG} = \frac{x'}{l} \times \frac{l - r}{h} \quad (2)$$

in which x' may have any value from zero to $r - P_1$.

For the unit load in panel CE—placed for convenience at d' —the value of the tensile stress $d'e'$ is i''/h_1 , since the triangle $d'e'e$ may be considered as a polygon for the forces at d' , the length $e'e$ ($=h_1$) representing the unit load and length $d'e'$ ($=i''$) the stress $d'e'$. Expressing the moment of stress $d'e'$ about e as its horizontal component, p_1/h_1 , multiplied by h_1 , the fol-



lowing equation of moments of stresses and external forces to the left of section 1-1 about e may be written:

$$R_a \cdot r - 1 \cdot p_1 + \frac{p}{h_1} \cdot h$$

horizontal component $EG \cdot h = 0$,

$$\text{or since } R_a = \frac{l - r + p_1}{l},$$

$$\text{horizontal component } EG = \frac{l - r + p_1}{l} \cdot \frac{r}{h} \quad (3)$$

Equations 1, 2 and 3 may now be used to construct the influence line for the horizontal component of stress

EG. Referring to Fig. 2 (a), ne and ac are graphs of equations 1 and 2 respectively. These lines may most conveniently be drawn by observing, first, that the intercept aa' on line (2) of ne prolonged is r/h , the value of equation 1 for $x = l$; and second, that equations 1 and 2 are identical for values of $x = l - r$ and $x' = r$ respectively, so that ac prolonged traverses e . Next, lay off on line (4) the ordinate $d'd$ equal to equation 3; then, since an influence line for any function is a straight line between successive panel points in the floor system, the lines cd and de complete the influence line across panel CE. But for $x = l - r + p_1$, equation 1 becomes identical with equation 3; therefore d must fall on ne prolonged. This is also evident from the fact that for any position of the unit load between e' and d' the moments about e of the load and stress $d'e'$ neutralize each other, thus leaving in the moment equation only R_a and stress EG, as in equation 1.

INFLUENCE LINES FOR CHORD STRESS EG

The complete influence line is $acdn$. If $d'e'$ were removed, the influence line would be $acen$, which is typical of the simple Pratt truss. Incidentally, this is the form of the influence line for stresses CE and ce in Fig. 1, since a section similar to 1-1 through these members traverses only four members—there being no member at c' corresponding to $d'e'$. An ordinate between ce and cde , Fig. 2 (a), therefore represents an increase in the horizontal component of the chord stress EG induced by the secondary system in panel CE, the value of dd' being equal to p_1/h . An analysis of stress EG of the sub-Pratt (Pettit) truss illustrated in Fig. 3 (a) leads to an influence line identical in form with $acdn$, the only difference being that here the secondary system which causes the increase in stress referred to above is that in panel EG, so that the triangle corresponding to cde , Fig. 2 (a), will appear in that panel, instead of in panel CE. A comparison of the secondary systems of the two trusses is given later.

Bottom-Chord Stress eg —Referring to section 1-1, Fig. 1, it is seen that the algebraic sum of the horizontal components of stresses EG, $d'e'$ and eg must equal zero, which furnishes a simple method of determining stress eg . Thus, with the unit load in any position outside of panel CE, stress $d'e'$ is zero, and the horizontal components of stresses EG and eg must be equal in magnitude and opposite in direction. Therefore equations 1 and 2 apply for the horizontal component of stress eg , which, however, is tensile instead of compressive. The corresponding influence lines are ne and ac , Fig. 2 (b), drawn as explained for Fig. 2 (a).

STRESS FOR UNIT LOAD AT d'

With the unit load at d' , the horizontal component of stress $d'e'$ ($=p_1/h_1$) acts in a direction opposite to that of the horizontal component of stress EG, whose value is given by equation 3. Therefore

$$\text{horizontal component } eg = \frac{l - r + p_1}{l} \times \frac{r}{h} - \frac{p_1}{h_1} \quad (4)$$

To complete the influence line, Fig. 2 (b), prolong ne to d' , and lay off $d'd$ equal to p_1/h_1 . Since the ordinate to d' is equal to the first expression in the right-hand member of equation 4, the ordinate to d is equal to equation 4, and the complete influence line is $acdn$.

The ordinates to this line must be multiplied by P''/P to obtain the value of stress eg .

The influence line for this stress is of different form from that for stress eg of the Pettit truss, Fig. 3 (a), which, since the latter member is unaffected by the secondary system, may be represented by $acen$, Fig. 2 (b). An ordinate between ce and cde therefore represents a decrease in the horizontal component of the chord stress eg induced by the secondary system, the value of $d'd$ being equal to $p_1 h_1 / h$; while it is evident that an ordinate between cde and $cd'e$ at any point is equal to the horizontal component of stress $d'e'$ from a unit load at that point.

Thus it is seen that while in the Pettit truss the secondary system affects the stresses in only one chord system, in the K-truss both chord systems are affected, the stress in the top chord being increased and that in the bottom chord decreased. If such members as $d'e'$, Fig. 1, were arranged to act as struts instead of ties by being connected to the upper of the two diagonals, the effect would be to decrease the top and increase the bottom-chord stress. Finally, if the secondary systems in either truss are removed, the analysis reduces essentially to that of the simple Pratt truss.

WEB STRESSES

Diagonal Stress $e'G$ —Imagine the truss to be divided into two parts by a vertical section 2-2 cutting four members, Fig. 1. To determine stress $e'G$, it is desirable to select, if possible, a moment center about which the algebraic sum of the moments of the stresses in the other three members cut will be zero, thus leaving stress $e'G$ as the only unknown factor in the moment equation. O_1 is such a moment center for any position of the unit load outside of panel CE. This may be demonstrated as follows: As previously explained, for such a position of the load the horizontal components of stresses EG and eg are equal in magnitude and opposite in direction. Hence the resultant of these stresses must be a vertical force through their intersection O ; this resultant and stress $e'f'$ both traverse O_1 ; therefore the sum of the moments of stresses EG, eg and $e'f'$ about O_1 is zero.

The stress in $e'G$ for loads outside of panel CE may therefore be determined in exactly the same way as the stress in any diagonal web member of a Pratt truss with inclined chords, the only difference being that the moment center in the latter case lies at the intersection of the chords. Thus, for the unit load in any position from f' to the right, letting x equal the distance from the right support, the compressive stress is

$$e'G = \frac{r}{l} \times \frac{v}{z} \quad (5)$$

Similarly, for the unit load in any position from c' to the left, letting x' equal the distance from the left support, the tensile stress is

$$e'G = \frac{x'}{l} \times \frac{l+v}{z} \quad (6)$$

For the unit load at e' , stress $d'e'$ is still zero and equation 6 applies by substituting r for x' .

With the unit load at d' , consider that part of the truss to the right of section 2-2. Since $d'e'$ is now stressed, the horizontal components of stresses EG and eg are no longer equal, their algebraic sum now being equal to the horizontal component of stress $d'e'$ or p_1/h_1 ,

as previously explained. The resultant of stresses EG and eg is therefore no longer a vertical force traversing O_1 , but an inclined force through O whose horizontal component is p_1/h_1 . The moment of this force about O_1 , equal to its horizontal component multiplied by OO_1 , must now be included in the equation of moments of forces to the right of section 2-2, which may be written:

$$e'G \times z - R_n(l+v) - \frac{p_1}{h_1} \times \frac{t+P}{P} h = 0,$$

or, since $R_n = \frac{r-p_1}{l}$, the tensile stress is

$$e'G = \frac{r-p_1}{l} \times \frac{l+v}{z} + \frac{p_1}{P} \times \frac{t+P}{z} \quad (7)$$

The influence line may now be constructed. Equations 5 and 6 are plotted in Fig. 2 (c) as nf and ac respectively. For convenient construction, note the familiar property that the intercepts aa' and nn' are equal, respectively, to v/z and $l+v/z$, showing that nf and ac prolonged intersect on the vertical through O_1 . Prolong ac to e , and draw ef ; s marks the position of a load for zero stress in $e'G$. Finally, prolong ge to its intersection d with the vertical line (4); the ordinate $d'd$ is equal to equation 7, the proof of this construction being given in the figure. The complete influence line is therefore $acdefn$.

If $d'e'$ were removed, the influence line for stress $e'G$ would become $acefn$, which is typical of trusses with single web systems, and, incidentally, is the form of influence line for stress $c'E$ in Fig. 1, since there is no member at c' corresponding to $d'e'$. Therefore the ordinates from ce to cde , Fig. 2 (c), represent the increase in stress $e'G$ induced by the secondary system in panel CE, the value of $d'd$ being equal to the last term in equation 7. For a K-truss without sub-panels the influence line would take the familiar form $acegn$.

Diagonal Stress $e'f'$ —The moment center for this stress is O_2 , and the analysis is similar to that for stress $e'G$. Thus, equations 5 and 6 apply by substituting z_1 for z and reversing the character of stress. The segments ac and efn of the influence line, Fig. 2 (d), require no explanation beyond noting that the intercept aa' is here equal to v/z_1 .

With the unit load at d' , the analysis leading to equation 7 may be applied to stress $e'f'$, O_2 being the moment center instead of O_1 . Then the value of the compressive stress is

$$e'f' = \frac{r-p_1}{l} \times \frac{l+v}{z_1} - \frac{p_1}{P} \times \frac{h_2}{h_1} \times \frac{t+P}{z_1} \quad (8)$$

To complete the influence line, measure $aa'' = h_2 v / h_1 z_1$, prolong oa'' to g'' and draw $g''e$ to its intersection d with line (4); the ordinate $d'd$ is equal to equation 8 as proved in the figure; or the last term in equation 8 may be computed and plotted directly as $d'd$. The ordinates from ce to cde represent the decrease in stress $e'f'$ induced by the secondary system in panel CE.

Diagonal Stress $f'g$ —Stresses $e'f'$ and $f'g$ are evidently equal except for loading in panel EG, which brings a floorbeam concentration at f' . Therefore the influence line for stress $e'f'$, Fig. 2 (d), applies to stress $f'g$ except across panel EG; and the influence line for the stress $f'g$ may be completed by determining the value of that stress for a unit load at f' .

For that position of the load, the triangle $f'g'g$, Fig.

1, may be considered as a polygon for the forces at joint f' , the length $g'g$ representing the unit load. The force represented by gf' ($= i_1'/h_1'$) is the resultant of stresses $e'f'$ and $f'g$ due to that load. Stress $e'f'$ is tensile—equal to the ordinate $f'f$, Fig. 2 (d)—and stress $f'g$ is compressive or tensile according as stress $e'f'$ is less or greater than i_1'/h_1' . The former condition usually obtains, and the following equation gives the value and sign of the stress:

$$f'g = e'f' - \frac{i_1'}{h_1'} \quad (9)$$

It will be convenient to express i_1' in terms of z_1 . Thus $i_1' = pi_1/P$, and $i_1 = th'/z_1$ (from the value for z_1 , Fig. 1); substituting, equation 9 becomes

$$f'g = e'f' - \frac{p}{P} \times \frac{h'}{h_1'} \times \frac{t}{z_1} \quad (10)$$

Now, since $f'f$, Fig. 2 (d), is equal to stress $e'f'$,

if a point f_1 is found such that $f_1f = \frac{p}{P} \times \frac{h'}{h_1'} \times \frac{t}{z_1}$

$f'f_1$ will equal stress $f'g$. Measure $a'a''' = \frac{h'}{h_1'} \times \frac{v}{z_1}$

prolong oa''' to e'' and draw $e''g$; f_1 is the point of intersection of $e''g$ with the vertical line (6). The proof of this construction is given in the figure. By using equation 10 rather than equation 9 to locate f_1 , it is clearly shown that ef_1g is always concave upward, since e'' cannot lie above e ; further, that $e''g$ is a locus for point f_1 for various values of p , assuming panel point g' fixed in position—that is, h_1' constant. The complete influence line is $acdef_1gn$; s_1 marks the position of a load for zero stress in $f'g$.

The influence line for the corresponding member of a Pettit truss— $f'g$, Fig. 3 (a)—takes the form $acegn$, Fig. 2 (d); that is, it is a straight line across panel EG, as distinguished from the broken line ef_1g for the K-truss. It is interesting to note, however, that ef_1g approaches the straight line eg as a limit if the point g' in the K-truss is assumed to approach G, since then the ratio h'/h_1' approaches unity and e'' approaches e , Fig. 2 (d). In fact, to carry such a change in the K-truss to the limit of coincidence of g' with G, e' with E, etc., virtually destroys its identity, and reduces it to the Pettit type.

Sub-Diagonal Stress $f'g'$ —This stress is zero except for loading in panel EG, and for a unit load at f' its value (tension) is

$$f'g' = \frac{i_1'}{h_1'} \quad (11)$$

For such a simple case an influence line is unnecessary, the maximum stress being developed concurrently with the maximum floorbeam concentration at f' . An interesting point to observe, however, is that the vertical ordinate included between the lines ef_1g and ef_1g , Fig. 2 (d), at any point is equal to stress $f'g'$, due to a unit load at that point, multiplied by z_2/z_1 , in which z_2 is the lever arm (not shown) of stress $f'g'$ about O_2 . This may be proved from the construction of the figure, or by taking moments about O_2 of the stresses and external forces to either side of section 3-3, Fig. 1, with the unit load at f' . A similar relation exists with the Pettit truss, in which case the corresponding influence lines are eg and ef_1g , Fig. 2 (d), the member $f'g'$ becomes $f'G$, Fig. 3 (a), and the values z_2 and z_1

represent, respectively, the lever arms about the intersection of the chords of members $f'G$ and $f'g$, Fig. 3 (a).

Stresses in Vertical Posts—These stresses follow directly from those in the diagonals. Thus, by resolving stress $e'G$ into components at G in the directions EGK and Gg' , it is seen that

$$Gg' = e'G \times \frac{h_2}{i_2} \quad (12)$$

and that the stresses in the two members are of opposite character. Therefore, Fig. 2 (c) may be used as the influence line for stress Gg' by multiplying the ordinates by h_2/i_2 . In like manner the ordinates to the influence line for stress $f'g$, multiplied by h_2/i_2 , represent the stress in the lower part $g'g$ of post $g'g$; the stress in the upper part $g'g'$ is equal to that in the lower except when there is a floorbeam load at g'' .

The construction of certain of the influence lines is simplified if the sub-diagonal and main diagonal in a

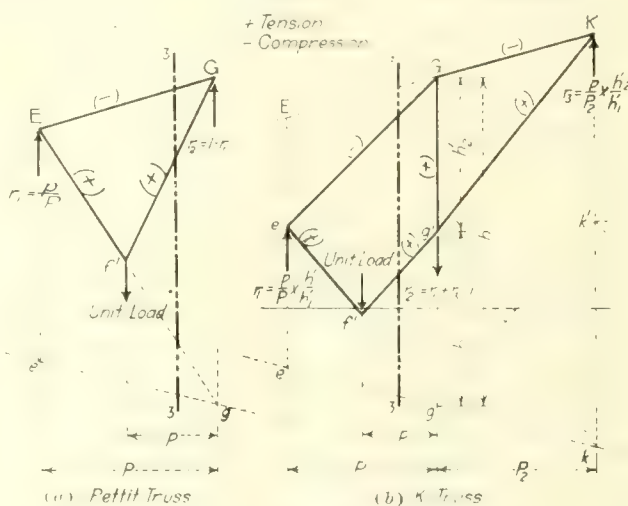


FIG. 3
Showing Action of Secondary Systems

given panel are parallel. Thus, if $d'e'$ and $c'E$ are parallel, line cd in Fig. 2 (b) will be parallel to en , and cd in Fig. 2 (d) will be parallel to eg ; while if $f'g'$ is parallel to $e'G$, line ef_1 in Fig. 2 (d) will be parallel to fn . No convenient relations seem to obtain, however, for the usual case of equal length of sub-panels ($p = P/2$, etc.).

COMPARISON OF "SECONDARY SYSTEMS"

A comparison between the so-called "secondary systems" of the Pettit and K-trusses can now be made. In the Pettit truss, Fig. 3 (a), the frame $Ef'G$ acts as a secondary truss system in transmitting any load at f' in proportionate parts to the main panel points E and G. In the K-truss, Fig. 3 (b), for a unit load at f' , the secondary truss system is $e'f'g'KG$ (shown by full lines), since $e'G$ and $g'K$ —in the absence of a member $e'g'$ corresponding to EG of the Pettit truss—must develop the horizontal components of stresses $e'f'$ and $f'g'$ respectively.

Evidently, then, the load at f' is not transmitted proportionately to e' and g' ; nor is it transmitted proportionately to e' and K, since the secondary truss—owing to the presence of the quadrilateral frame $e'f'g'G$ —would be unstable if supported simply at these two points. The truss would be stable, however, if supported at e' , g' and K.

Moreover, the reactions r_1 , r_2 and r_3 at these points

are not statically indeterminate, as they would be if the quadrilateral frame were braced by the insertion of members $e'g'$ or $f'g'$. In fact, the presence of this frame, free to deform without change in length of its sides, furnishes the third condition (the other two being $\Sigma V = 0$ and $\Sigma M = 0$) required to determine the reactions by statics. (A familiar application of this principle is seen in the omission of diagonal bracing in the panel over steel supporting towers at the main piers of a cantilever bridge.) Thus, the value of r_1 may be found by applying the laws of equilibrium to joints f' and e' ; with r_1 known, r_2 and r_3 are readily determined. The values of these reactions, and the character of the stress induced in each member of the secondary system, are indicated in Fig. 3 (b). (For the general proportions shown, r_2 is negative.) The load at f' must therefore be assumed to be replaced by *three* component concentrations at e' , g' and K , equal and opposite to the reactions r_1 , r_2 and r_3 ; the function of the secondary system being completed, $f'g'$ is no longer needed and the primary K-system transmits these concentrations to the supports.

CRITERION FOR STABILITY SATISFIED

It is appropriate here to direct attention to the fact that the K-truss, in either its primary form or with sub-panels, satisfies the familiar criterion for stability expressed by the equation $m = 2j - 3$, in which m is the number of members and j is the number of joints; so that the presence of the quadrilaterals $e'f'g'G$, etc., in the truss with sub-panels does not necessarily imply instability. That is to say, a truss does not of necessity have to consist of an assemblage of triangles in order to be stable; and in this case such members as $e'g'$ or $f'g'$, inserted to reduce the truss to an assemblage of triangles, would be redundant, thus making the stresses in general statically indeterminate, as shown in the preceding paragraph by independent consideration of the secondary truss.

This analysis of the secondary system may be used to advantage in computing stress $f'g'$, in either the Pettit or K-truss, by algebraic methods, since the sub-diagonal is eliminated from the forces at section 3-3, Fig. 1, without stressing $f'g'$, which is not in the secondary system. On the other hand, its use in the determination of chord stress EG by the elimination of $d'e'$ (see section 1-1, Fig. 1) complicates rather than simplifies the work, since the stress in EG induced by its action in the secondary system must be determined and included in the final equation for stress.

The secondary system $k'mn'm'$ in panel KN , Fig. 1, serves to transmit a load at m proportionately to k' and n' , as in the Pettit truss, after which the secondary members may be considered removed and the stresses in the primary K-system determined by the methods which have been developed, noting, however, that $k'm$ acts as a member of both the secondary and primary systems.

[TO BE CONCLUDED]

Frontier Humor in an Official Report

In the last annual report of the Board of Road Commissioners for Alaska it was noted that "Alaska abounds in mineral wealth, fish and road-commission critics."

Denver Advised to Purchase Its Present Waterworks

Investigations Show Cost of a New System to Be Double That of Present Fixed Valuation Existing Supply Ample

THE cost of a proposed municipal waterworks system for Denver has been estimated at \$27,479,500, a figure more than double that of \$13,415,899 given in a special master's report as the valuation of the existing Denver Union Water Company's works. The wide variation is due to the necessity of obtaining a supply from the Blue River, on the western side of the Continental Divide, as the remaining local sources of supply were found to be insufficient. In a report recently submitted to the Public Utilities Commission of Denver by H. A. Kluegel, chief engineer and G. H. Wilhelm, consulting engineer for Shirley Houghton, successor to the Van Sant-Houghton Company, engineers and contractors, of Denver and San Francisco, it is also claimed that the present supply is sufficient to meet Denver's needs for the next 20 years, and a purchase of the present waterworks system at the stipulated valuation is recommended.

THE SITUATION

The Public Utilities Commission, on July 27, 1915, employed the Van Sant-Houghton Company to complete the engineering work and to prepare plans, specifications and estimates for a complete and adequate system of waterworks to replace the existing system, owned by the Denver Union Water Company. A year previous to this, the city council had passed an ordinance regulating and fixing the charges by the Denver Union Water Company for water furnished the city and its inhabitants. The water company brought suit and received a favorable verdict in the United States District Court. As a result, the investigations of a new system were instigated and later the Van Sant-Houghton Company was employed.

An option agreement was executed Feb. 21, 1916, between the water company and the city granting to the latter an option to purchase the company's property at a valuation, as fixed by the special master's report, of \$13,415,899, or as modified by certain additions and accrued depreciation. This agreement, in turn, bound the city to take an appeal of the rate case to the Supreme Court and to enter into no further contracts leading toward the duplication of the system. The city then instructed the Van Sant-Houghton Company to investigate also the condition of the existing waterworks system. Later, a supplemental contract was made calling for the discontinuance of all investigative work and the preparation of a preliminary report, the source of the following notes.

INVESTIGATING FOR A NEW SOURCE OF SUPPLY

When the Van Sant-Houghton Company was employed, the Public Utilities Commission suggested that the water supply be developed from within the South Platte drainage area, which is adjacent to Denver, and presented for consideration the following: (1) The ownership and operation of certain existing ditches; (2) the acquisition and operation of the Antero reservoir and the high line canal; (3) the selection of a res-

ervoir site at the junction of the north and south forks of the South Platte; (4) the supply required for Denver with a population of 500,000 at a rate of 150 gal. per capita per day would be 84,041 acre-feet per annum; (5) the addition of a supply from the western slope, probably from the Blue River, in case the above supply proved insufficient. These suggestions were considered, together with such additional investigations and studies as were found necessary.

In determining the supply available from the eastern slope, a study was made of the existing water rights on the basis of the maximum allowable consumption, and a systematic development of the affected territory was considered in order that the maximum supply of water might be obtained. It was found that the Denver reservoir, located at the forks of the South Platte, would provide a storage capacity of 56,414 acre-feet, but that only 13,000 acre-feet of water could safely be estimated from the South Platte district, with an additional amount not exceeding 10,000 acre-feet from the Tarryall area if stored at the McKay reservoir site.

INVESTIGATION OF WESTERN SLOPE

This led to the investigation of the western slope possibilities, with a preference toward the Blue River project, which indicated a probable supply of 88,270 acre-feet. It would be necessary to carry the water from the Blue River through a tunnel to a stream leading to the Tarryall Creek and McKay storage sites and thence to the Denver reservoir. This would give a total supply of 111,270 acre-feet, which, less possible evaporation, might be reduced to 100,000 acre-feet.

From the Denver reservoir, with its dam 210 ft. high, a conduit of some 20 miles in length would carry the water to the purification works, which would have a capacity of 80 to 100 million gallons, sufficient to care for the city's existing needs. Rapid sand filters were proposed, together with preliminary subsidence and coagulation, and final disinfection. To care for peak demands, a storage reservoir was included in the distribution system. Because of existing hills a west-side pumping station and standpipe became necessary. The estimate of cost for this system, as given above, was found to be \$27,479,500.

THE PRESENT SYSTEM

A study of the Denver Union Water Company's works, the report states, revealed resources amply sufficient to supply the maximum demand of 84,041 acre-feet per annum. Based on the recorded flow in the river during the last 40 years and on recorded amounts of storage, it is estimated that with an unheard-of failure of all sources of supply the probable minimum storage alone would supply the needs of the city for over four months. The per capita quantity of 150 gal. per day is commented upon as being neither economical nor necessary and subject to a reduction. With this in view it is claimed that the present supply will meet all demands for the next 20 years without the necessity of developing further resources.

The basis of the financial schedule is that the city acquire the property of the Denver Water Company by the issuance of bonds in the amount of \$14,000,000 payable in 40 years and bearing $4\frac{1}{2}$ per cent interest. A study of the operations of the company, modified to municipal-

ownership conditions, gives a gross revenue of \$1,300,000 and an operating expense of \$280,000 for the first year. The bond sinking fund would commence in the third year and continue on a graduated scale so as to retire the bonds in the fortieth year. A 10-per cent reduction in present rates is expected by the eighth year. The surplus allows a high state of efficiency to be maintained.

In conclusion, H. A. Kluegel, chief engineer, recommends that the property of the Denver Union Water Company be acquired under the terms of the above-mentioned option agreement, adding: "The adequacy of the developed water resources can be asserted with greater assurance than that of any projected system, the plant is in active operation, the financial result can be forecast with certainty, while the difference in cost is so great as to fully justify it from an economic point of view."

Sink Concrete Cofferdam in Sand for Activated-Sludge Plant

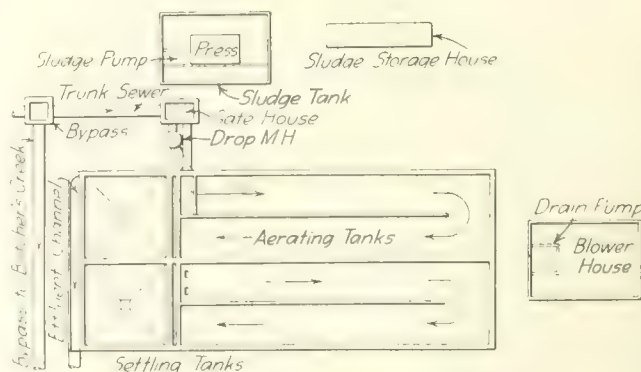
Small Town Works to Treat 1,000,000 Gallons of Sewage—Hydraulic Excavation with Centrifugal Pumps

INSIDE a concrete cofferdam sunk 22 ft. into a water-bearing sand, settling tanks for a new 1,000,000-gal. activated-sludge plant are being built at Escanaba, Mich. Hydraulic excavation and the simple design of the whole works are the features of the plant.

The works are located at the south end of the city, at the outlet of a new $3\frac{1}{2}$ -mile trunk sewer and about 2 miles from the outlet of the old trunk sewer. The new trunk serves a district which is not as yet very thoroughly settled except at the extreme north end, and will provide a flow for the next few years not to exceed 300,000 gal. per day. The old sewer, which has practically all the connections it will ever have, serves about 10,000 persons using 100 gal. of water per day. Plans and estimates have been made for a pumping station and force main to connect the old system with the disposal plant, the work to be done this season.

DAILY CAPACITY 1,000,000 GALLONS

The general layout consists of two long rectangular aerating tanks with a longitudinal vertical baffle, so that the inlet and outlet are at the same end, the end adjoining the two settling tanks. The total capacity of the aerating tanks is 220,000 gal.; and as one-half



AERATING TANKS ARE SIMPLE LONGITUDINAL BASINS WITH SINGLE BAFFLE

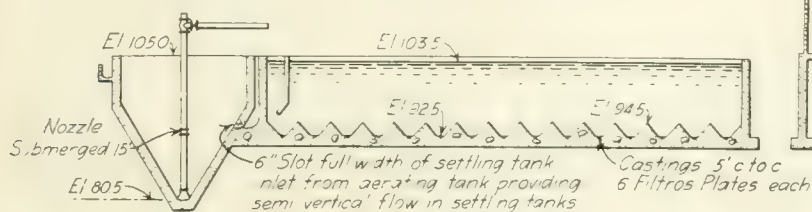
of the total flow occurs in nine hours, a four-hour aeration period will give a daily capacity of nearly 1,000,000 gal.

The total capacity of the two settling tanks is 86,000 gal., which will give, with the corresponding four-hour aeration period, 93 minutes for the sedimentation period. By decreasing the aeration period to three hours the sedimentation period will be 70 minutes and the capacity of the plant will be 1,300,000 gal. per day.

Filtros plates having an area of 360 sq. ft. are used in the ridge and valley aeration tank, which has an area of 30,000 sq. ft. Thus the diffusion ratio is 1 to 8.3.

Air is to be distributed to the base of the plates from a Taylor spiral-riveted, galvanized-steel header, diminishing in size from 8 in. to 6 in. and then to 4 in. The drops from the header are 4-in. Byers galvanized wrought-iron pipe. All the valves have iron bodies and are bronze mounted with rising stems. The blower house is located at the opposite end of the aerating tanks from the settling tanks, and inserted in the main is a Venturi meter with U-tube monometer. Two Connersville blowers will furnish the air. The rated capacities are 1200 and 2400 cu. ft. per minute, and the motors driving them are 40 and 75-hp. General Electric 2200-volt motors.

Four 6-in. drain pipes, laid lengthwise of the aerating tanks, have 4-in. openings at each casting. They are connected with a 6-in. Fairbanks-Morse centrifugal



LONGITUDINAL SECTION SHOWS CONNECTION BETWEEN SETTLING AND AERATION TANKS

pump located in a pump pit under the blower-house floor.

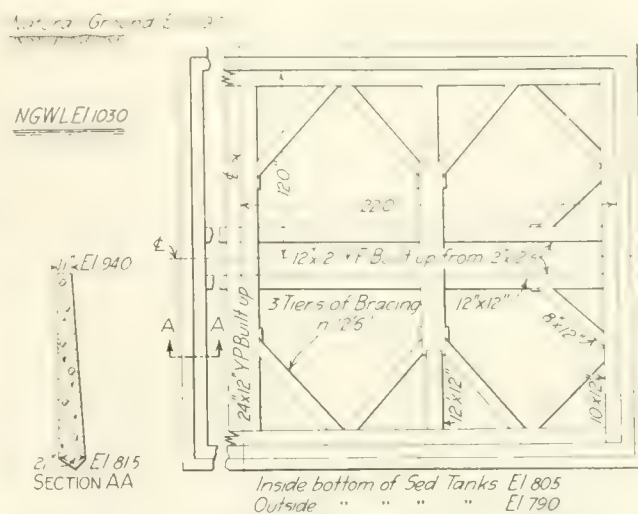
Sludge will be removed from the settling tanks by Harris nozzles through 8-in. cast-iron pipes back into aerating tanks, or to the sludge tank in the press house, where it may be further aerated from a 1-in. wrought pipe grid with perforations in the pipes 1 in. apart. From the sludge tank the sludge will be pumped by a 3-in. motor-driven centrifugal pump into a 6 x 9-in. Worthington filter press. The cakes will be wheeled to a small shed adjacent and stored on racks until disposed of. The supernatant water in the sludge tank will be drawn off by a perforated steel pipe on a flexible elbow, discharging into the drain sump at the blower house.

EXCAVATE COFFER HYDRAULICALLY

High ground-water level was at El. 103, making a head of about 24 ft. for the contractor to work against in getting in the points of the settling tanks. Excavation down to water, 6 ft., was carried out by team and scraper.

A concrete cofferdam, 24 x 44 ft. in inside dimensions and 5 ft. deep, was then built around the site of the settling tanks. The manner of bracing is shown in the drawing.

A 4-in. Morris centrifugal pump, driven by an 8-hp.



COFFERDAM WAS CROSS-BRACED THOROUGHLY WITH BUILT-UP TIMBERS

Novo gas engine, was placed on the cross-bracing. A sump midway between the points of the settling tanks was dug by hand and the pump started. The discharge side had a tee next to the pump, one outlet of which led to the spoil bank and the other to a 1½-in. nozzle on a fire hose. When the water in the sump had been pulled down deep enough, the nozzle was turned on and the sand washed from under the wall into the sump. In this way the first 5-ft. section was lowered its full length. Then a 7½-ft. section was added to it, and after a week's curing pumping was resumed, using this time a 25-hp. motor instead of the gas engine. The cofferdam was sunk as before

until the bottom edge reached El. 81.5, when it was a simple matter to place forms and concrete in the dry. The material was uniformly a medium coarse sand. Water from the excavation for the aerating tanks was led to the cofferdam pump, so that one pump took care of practically all the water.

In sinking the cofferdam from El. 103.8 to 81.5, cracks opened at about the center of each wall and in two opposite corners. When sinking was discontinued, cracks on three walls were open not more than ¼ in., and on the fourth wall next to the excavation for the aeration tanks the crack opened 1½ in. at the top and was closed at the bottom.

The total cost of the plant, including the press, blowers, motors, and pumps, is \$38,750. The designs were made by W. J. Hodson, city engineer. M. B. Jensen, his assistant, is in charge of construction. Samuel Mills is the contractor.

Chilean Contractors Listed

A list of the contractors registered in the Department of Public Works of the Chilean Government has been compiled by Verne L. Havens, commercial attaché at Santiago. The list will be loaned on request to the Bureau of Foreign and Domestic Commerce, Washington, D. C. Inquirers should refer to File 2179.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Design of Proposed Multiple-Arch Dam in New Mexico Discussed

SIR: On page 604 of your issue of Nov. 11, 1916, there occurs a photograph showing a proposed multiple-arch dam of a very interesting type. Below this picture your reporter has added certain notes which add distinctly to the interest. The multiple-arch dam is a comparatively new development. The existing structures have been designed and built by specialists in this particular line, as have most of the buttress dams of other types. No multiple-arch dam failures have occurred.

Until the general principles underlying the successful use of this and other forms of structural dams are very generally understood it is important that no misstatements nor improper designs of this class of structure should be permitted to pass unnoticed. I therefore wish to call attention to certain important respects in which the design as published needs correction before it can result in a stable and safe dam.

The construction of a dam on a mattress assumes flexibility, or at least a structure of a form that will be stable after settlement has occurred. In a multiple-arch dam the thrust of the face arches is balanced as long as they remain in their intended place. If during settlement the moving buttress moves out of alignment in either a horizontal or a vertical plane the thrusts are no longer in line and balanced across the entire face of the structure. If the buttress has also settled sidewise and is tending to overturn sidewise this condition is aggravated. As settlement must involve both of these tendencies it is evident that extreme care must be used in placing such a dam on a soft, yielding base.

The more nearly an arch approaches the semi-circular the less the side thrust on its buttresses is balanced by its mates. The less the subtended arc, the greater the thrust. Multiple-arch dams depend for arch stability on the balancing of these thrusts, and to secure a high degree of safety they must be made small by using arches as nearly semicircular as can be had.

There is another reason for the use of short radii, and that is that the load, and so the thickness of the arch, varies inversely with the radius. As too short a radius would result in too close a buttress spacing for the minimum of materials, considerable care needs to be taken in selecting these important constants.

But the buttress stands as an unsupported wall or column free on three sides for much of its length, so that the unsupported length of its rear edge, its weakest section, may determine the stability of the entire dam. The spacing and size of the struts will be determined by the requirements at this edge. And not only static but vibratory stresses tend to concentrate here.

In well-loaded materials, such as the concrete and steel of such a dam, minor shocks and repeated rhythmic

stresses of a vibratory nature must be carefully avoided as tending to open up structural defects. Therefore there should be avoided any tendency to produce water shocks. The spillway should be a smooth rollway with the shock and energy absorbing devices in the stream bed well below the main structure. If at all possible the spillway should be entirely independent of the dam. If it must be on the dam it should discharge the water in a smooth, shallow stream.

On torrential streams the spillway must be a free opening. Neither hand nor automatic gates should block the free flow of the floods. This is particularly important where any impeded flow is apt to pass over portions of the wall from which it can drop on soft unprotected foundations.

The use of a concrete girder or slab, loaded edge-wise, 400 ft. long and 200 ft. deep, to carry a load of 150,000 tons applied at an angle to the flat face of the slab is unusual, but may be possible. But the use for this purpose of a relatively thin slab attached to friable and yielding supports or end seats and resting on loaded piers spaced along its length appears to be undesirable. As these loaded piers settle the slab will receive unexpected side loads and be fractured and bent out of line with its own load.

It would be so thick that but few weep holes could be provided through it, and yet so light as compared with the possible uplift pressure that it might be ruptured by reversal of pressure from seepage from the cut-off wall.

The illustration presents other undesirable features, but none so likely to render the entire enterprise futile as those outlined above.

Los Angeles, Cal.

RALPH BENNETT,
Consulting Engineer.

[Mr. Bennett's letter was submitted to A. G. Hillberg, designer of the dam in question, and his reply follows.]

SIR: Mr. Bennett has raised some questions as to the safety of the design prepared by me for the dam of the Rio Grande Light, Heat & Power Company. It is unfortunate that the picture prepared from the drawings does not give complete details of the design, but how could it do so? Actual photographs of engineering structures generally show very little of the details, and how, then, could a picture, made by an artist without engineering training, be made to show more? Consequently, I think that Mr. Bennett's reference to "certain important respects in which the design as published needs correction before it can result in a stable and safe dam" is not justified, as the details of the design have not been explained.

The first question raised refers to the foundation mattress, and doubts have been expressed as to whether this part can be made stiff enough to act as a girder. As shown in the accompanying drawing, this mattress has a minimum thickness of 5 ft. 3 in. and its width in the up-and-down stream direction is 200 ft. On the

upper side the spread footings of the buttresses act as vertical stiffeners, while in the transverse direction three ribs, of which one is located on the upper side and two on the under side, stiffen the girder and serve to check deflections. The upper stiffener also serves as a seal between the mattress and the arches, and it is braced against the buttress footings. The ribs on the under side are braced underneath each buttress; in other words, at 25-ft. intervals. Reinforcement will supply additional strength to these ribs, as well as to the mattress.

In respect to the arches, Mr. Bennett does not seem to realize that they appear in a projection of 45 deg., and in addition there is the possibility that the artist has drawn them shallower than they actually have been designed. Everybody knows that the most economical subtended angle of an arch of circular shape loaded with a radially acting load is about 133 deg. and that the volume of the arch does not vary appreciably for variations in this angle between the limits of 120 deg. and 150 deg. In the case in question the radius of the intrados is constant and 12.5 ft. in length. This length is one-half the spacing on centers of the buttresses, so that really the subtended angle is 180 deg. However, the thickness of the buttresses cut in on this angle, so that it actually is somewhat smaller.

To offset this effect the radius of the extrados has also been kept constant, so that the thinning of the crown carries with it, comparatively speaking, a thickening of the haunch. This procedure also

has the advantage of enabling the standardization of the form-work, so that steel forms can be used.

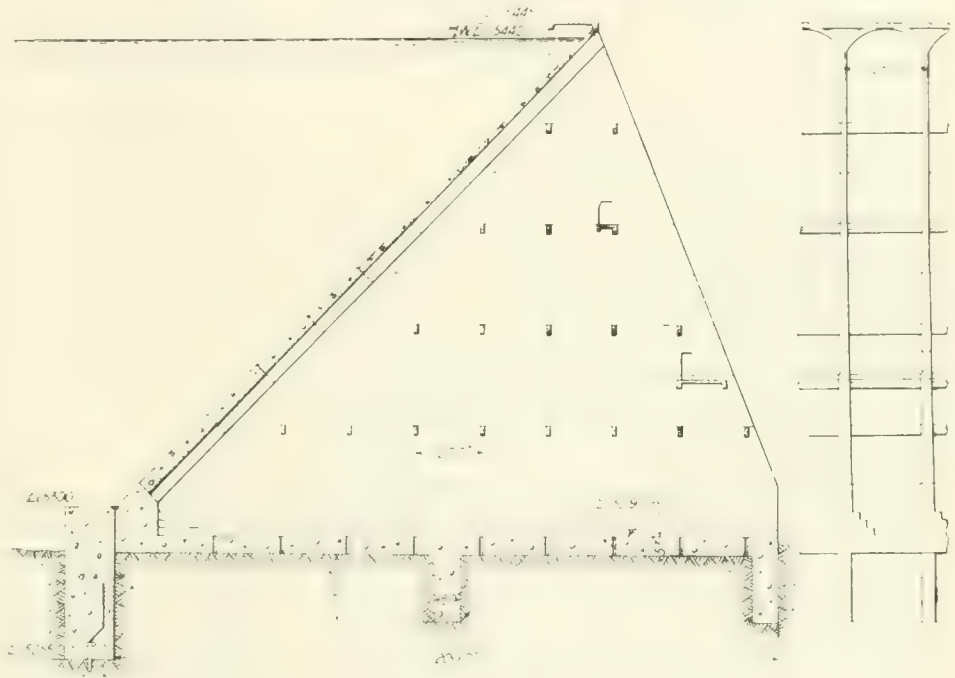
Another question has been raised as to the stability of the buttresses. It might be sufficient to indicate that these buttresses have been designed as cantilevers, held by the horizontal struts, so that should a row of arches collapse accidentally, the adjacent buttresses will be able to sustain the unbalanced arch thrusts from the adjoining panels.

In respect to the stepped spillway Mr. Bennett has advanced the theory that the discharge over it will tend to create rhythmic vibrations. The writer has been in the position to observe a number of such spillways abroad, the type of construction being more common there than here, and has found that the flow changes constantly, so that rhythmic vibrations hardly can occur. Engineers have often heard the expression "trembling dams," meaning dams that vibrate when discharging. However, this is not due to the direct pounding of the water but to a vacuum underneath created by a falling sheet and the pulsation of the water level inside the nappe.

It must be admitted that the spillway question for this dam has been difficult to solve, and that the exist-

ing design might be modified before construction is commenced. First, a separate spillway, blasted out of the rock in the right bank, was investigated, but found too costly. The ogee shape was abandoned because of the softness of the foundation below the dam and the difficulty of building effective energy and shock absorbers. Under the proposed plan a riprap paving about 100 ft. in length will be placed below the spillway.

In respect to the torrential nature of the stream, I do not call a stream torrential when the maximum discharge observed during 25 years is 24,800 sec.-ft. and the drainage area about 150,000 square miles. Of course for safety the spillway capacity has been made far in excess of this requirement. As to the advisability of installing automatic crest gates, their cost is high and few of them are satisfactory when installed



GENERAL FEATURES OF PROPOSED MULTIPLE-ARCH DAM ON RIO GRANDE

at an inaccessible place, where it is difficult to make repairs.

A spillway without gates would be rather long and the available space is not sufficient. To provide a short and deep spillway without gates would mean a loss of storage, as the overflow would be about 14 ft. deep. As the reservoir, when full, has a length of about 15 miles and a surface area of approximately 1000 acres, it is obvious that there will be time enough to hoist a sufficient number of gates to accommodate an increase in the discharge.

The next question refers again to the safety of the mattress to carry the load of 150,000 tons. First, this load is nearer 200,000 tons than 150,000 tons, as a considerable reaction from the cutoff wall has to be taken care of. As the vertical loading of the foundations is about the same, the coefficient of friction, should the dam tend to slide, would be about one. This, of course, is not safe, assuming that the girder action of the mattress were insufficient to hold the dam in place.

To increase the load on the plane of sliding and at the same time place this plane at another elevation than the under side of the mattress the two stiffening ribs on the under side have been made deep enough to

develop a friction coefficient of about 40 per cent. The material inclosed between these ribs will act as a direct load on the plane of sliding thus determined, and in addition the difference between the active earth pressures on their upstream sides and the passive pressures on their downstream sides will also contribute to the resistance to sliding.

Uplift pressures on the base have been safeguarded against, first, by a deep cutoff, and, second, by weep holes through the mattress as shown.

It has been the intention to describe fully the features of the design of this dam, but that it has not been done before is explained by the fact that some modifications may be incorporated before the structure is built. Therefore at a later date a full description will be furnished, and it is hoped that it will clear up definitely any explanations that might appear unsatisfactory in this brief statement.

A. G. HILLBERG,
Hydraulic Engineer.

New York City.

Water the Chief Factor in the Making of Good Concrete

SIR: Nathan C. Johnson is always interesting in his forcible way of expressing his ideas on the subject of the mixing of concrete. His article in your issue of Dec. 30, 1916, page 790, should attract a great deal of attention, and undoubtedly it will. The writer was present recently at a meeting where representatives of various materials were trying to assist a city council to avoid making a mistake. The article by Mr. Johnson was used very effectively by a publicity man for a material not friendly to concrete. The writer had not seen the article, for he was busy when the Engineering Record was laid on his desk that afternoon. He read it eagerly, however, the following morning.

Mr. Johnson is following a lot of us who have been on record many years as opposed to too much water. He has, however, the advantage over many in that he has studied the subject with the aid of still-life and moving-picture cameras and the microscope. He can give pictures, and the modern man to-day does not like to read an article not well illustrated. He stops short, however, of telling us how much water to use, and says too little about the consistency of concrete.

Ten years ago the writer began writing into his specifications the following clause: "The contractor shall use only that amount of water which will make the concrete pasty and sticky and not free-flowing. It shall be of such a consistency that it will flow freely from a wheelbarrow, but the discharge must be assisted by hoe or shovel." He now recommends that the consistency shall be that of a medium-soft or soft tooth-paste, for it is not difficult to obtain a sample in the nearest drugstore.

It is not enough to tell men not to use too much water, but they should be told just how much water to use. Consistency is what we are to work for. When the writer started in business all concrete was mixed until it had the appearance of being damp rather than wet. A handful squeezed retained the imprint of the fingers when the hand was opened and the lump could be shaken down readily. The specifications required that the material be tamped until it quaked and free

water rose to the surface. That was an ideal consistency. The trouble was that the tamping was seldom carried to the proper point. The building blocks made in many plants, where the tamping is merely a light compacting, are a good example of how much of the old concrete was made. With the proper tamping it was good.

A number of laboratory experiments have been made in the last five years, and they all show that too much water is bad. A big drawback to the value of the published results is that the men who publish the results express the amount of water in percentage. Percentage of what? There is nothing in the printed pages to tell whether it is a per cent of the cement, of the sand-cement paste or of the whole mixture. One writer says we should use 10 per cent of water and another says 25 per cent. It is barely possible that each writer is describing the same consistency, but there is nothing to tell us that.

The writer was chairman last year of the committee on mixing and placing of concrete of the Second National Conference on Concrete Road Building, reporting to the convention in February, 1916. To obtain material for the report the committee made experiments in concrete mixing in the field. The T. L. Smith Company, of Milwaukee, laid a new concrete driveway in the plant, and the committee was allowed to take complete charge of the mixing and placing of the concrete. The complete report was printed in the report of the Second National Conference on Concrete Road Building, copies of which may be obtained from the Portland Cement Association in Chicago. Copies of the committee report alone may be obtained from the T. L. Smith Company, Milwaukee.

In these field tests it was found that the amount of water should not exceed 6 lb. per cubic foot of loose materials, which includes cement, sand and aggregate. If the sand and aggregate contain much moisture, the amount of water to add may be as low as 4 lb. per cubic foot of loose materials. The amounts stated will of course be varied according to the amount of moisture in the materials, bearing in mind that consistency is the big thing. This in general terms may be stated to be that of a soft or medium-soft tooth-paste, with the further limitation that no free water shall cover the surface when the mixture stands 5 minutes, and that it cannot run like water or cream from the wheelbarrow, cart or bucket in which it is conveyed from the mixer.

Next to the correct amount of water is the time of mixing. The water should begin running into the mixing drum just before the materials are dumped in. The mixing should continue for not less than 1 full minute after all the materials are in the drum. This is to insure the incorporation of the water, for it takes time to get it into all the voids. A long mix makes stronger concrete, for the reason that all the water is where it should be.

On this point, however, there needs to be a cautionary note sounded. One experimenter, a professor, published a statement that mixing 2 or 3 minutes was no better than mixing 1 minute or even $\frac{1}{2}$ minute. The writer took the matter up with him and found that he had not varied the amount of water with the time. This is where he made his mistake. For short-time

mixing more water is required. If a certain amount of water gives good results with a 1-minute mix, the amount should be reduced slightly for a 2-minute mix and still more for a 3-minute mix. With these reduced amounts of water and increased time of mixing the same consistency is obtained, and it is consistency we are trying for. Consistency has been very truly defined as being a jewel, and the concrete engineer should appreciate this fact. In our Milwaukee tests, which were rough field tests and not marked by laboratory refinements, it was found that there was a remarkable decrease in strength with additional water.

The writer does not like Clause 1 and Clause 2 of the specifications proposed by Mr. Johnson. These clauses deliver the contractor over into the hands of the engineer in a disagreeable manner. Such general clauses the contractors are just now seeing some hope of getting away from, and the Engineering Record has exerted a telling influence in this direction.

Clause 1 should read as follows: "The concrete used shall be of the proportions hereinafter set forth, and the contractor shall be permitted to vary the proportions to allow of the most economical use of materials, provided that the concrete shall show a strength to compression at the end of thirty days, when tested in an 8 x 16-in. cylinder, of not less than — pounds per square inch."

Clause 2 should read as follows: "No batch of concrete shall be considered as properly mixed until it has been in the revolving mixer drum for not less than 1 full minute after all the materials have been put in the drum. The mixer drum shall revolve with a circumferential travel of not less than 120 ft. nor more than 160 ft. per minute. The concrete when discharged shall be of a consistency which shall not be free-flowing, but shall be pasty and sticky and approximating to a soft tooth-paste. If the concrete stands 5 minutes in the forms or in any receptacle, there shall not be present a film or covering of water. The maximum amount of water permissible shall be 6 lb. per cubic foot of cement, sand and aggregate, and this amount shall be reduced if the materials carry so much moisture that 6 lb. of water makes a sloppy or over-wet concrete. If this amount of water does not produce a soft enough concrete with a mix of 1 minute, then the mixing shall be continued until the proper consistency is obtained, but the amount of water shall not be increased.

If the two clauses read as above written, then Clause 4 and Clause 5 presented by Mr. Johnson can be omitted, his Clause 3 being all right.

ERNEST McCULLOUGH,

Chicago.

Consulting Engineer.

[Copy of Mr. McCullough's letter was submitted to Mr. Johnson, whose reply follows.]

SIR: I have your favor of Jan. 17 inclosing a communication from Mr. McCullough.

The opening paragraph strikes the keynote of his reply. My article on the influence of water in concrete has been "used effectively by a publicity man for a material not friendly to concrete." It would seem as if the concrete interests should have been primed with equally conclusive evidence concerning this "unfriendly product" before coming to conference. Mr. McCullough is quite aware that unfriendly deductions are unwar-

ranted and may not be read into any of my writings, so far as concerns concrete when properly made. But the case of concrete is obtrusively before the bar of engineering opinion; and judgment will be pronounced according as inexorable natural laws which govern its making have been obeyed or violated. The writer takes this opportunity to voice his unqualified approval of the right kind of concrete for the right purpose and of his unqualified disbelief in all sorts of concrete for any and every purpose. Such of his studies as have been made public thus far have been given out in the hope of making successful uses of concrete more general than they have been in the past.

The second paragraph of Mr. McCullough's letter is misleading. The Portland Cement Association, with which Mr. McCullough is associated, has had unparalleled opportunities and facilities for years past to obtain information with regard to their product. Better facilities as regards still-life and moving-picture cameras and microscopes have been available to them than to myself, with the added and inestimable advantage of ample funds to prosecute research without, as the writer has occasionally done, straining of finances and personal strength to the limit in order to obtain results. And it is not discovery to say that the writer stops short of telling how much water to use, inasmuch as that fact is emphatically expressed in the body of the article on which Mr. McCullough comments; and in an address on Dec. 14, 1916, before the Portland Cement Association in New York City, that fact was again emphasized and an urgent plea made that the Portland cement manufacturers tax themselves one mill per barrel per annum for research, in order that quantity of water and other moot questions might be solved, so that the product, by the making of which they gain their livelihood and on the continued use of which the security of their invested millions depends, should not be sold, as at present, with no instructions as to its use.

It is difficult to comment concisely upon Mr. McCullough's letter. Mr. McCullough is too thoroughly an engineer and too conversant with concrete to really advocate some of the things given therein. Comparing concrete to tooth-paste is somewhat indefinite and rather difficult. At what temperature shall tooth-paste be when its consistency is sampled? When concrete embodying large aggregate is used, in what manner shall this consistency be approached? If exceedingly fine sand, such as is found in many parts of Texas, is used in the concrete, and relatively fine aggregate, shall 6 lb. of water, regardless of proportions, be adhered to, or may the temptation to add a pail or two per batch be indulged, to produce tooth-paste consistency? And in what manner and by what police power shall 6 lb. of water and prolonged mixing to produce tooth-paste consistency be forced upon a contractor, particularly one who may have been losing money for one reason or another? Is the Portland Cement Association willing to sell its cement only to those who will guarantee to mix for 1½ or 2 minutes, or would it be overjoyed to sell 5000 bbl. of cement, whether it was to be used by Mr. McCullough or by an African savage?

These matters are too real and of too great importance to be trifled with, or dismissed with apologies

either for myself or my writings, or for concrete and its limitations. A condition confronts the concrete industry which it has begun to heed, but the importance of which is not fully realized. In the move for industrial preparedness, are we to overlook the vital problems presented by this great concrete industry? Mr. McCullough's letter is interesting as a viewpoint, but

it misses the mark. Research and more research until this problem is solved is the insistent demand. A little light is showing ahead, but not the bright light that will give us the clear vision which is so vital a necessity.

NATHAN C. JOHNSON,
Consulting Concrete Engineer.

New York City.

Literature

For the Civil Engineer and Contractor

New Publications

MODERN UNDERPINNING—DEVELOPMENT, METHODS AND TYPICAL EXAMPLES. By Lazarus White, C.E., and Edmund A. Prentis, Jr., E.M. Cloth, 6 x 9 in.; 94 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., \$1.50 net.

HYDROELECTRIC POWER. Volume 1—Hydraulic Development and Equipment. Volume 2—Electric Equipment and Transmission. By Lamar Lyndon. Cloth, 6 x 9 in.; 499 pages and 360 pages respectively; illustrated. New York, McGraw-Hill Book Company, Inc. Volume 1, \$5 net; Volume 2, \$3.50 net.

PROCEEDINGS OF THE TWELFTH ANNUAL CONVENTION, AMERICAN CONCRETE INSTITUTE, 1916. Edited by the secretary and John M. Goodell. Cloth, 6 x 9 in.; 569 pages; illustrated. New York, H. D. Hynds, secretary, 30 Broad Street.

SEWAGE DISPOSAL FOR VILLAGE AND RURAL HOMES. By C. S. Nichols. Bulletin 41, Engineering Experiment Station, Iowa State College. Paper, 6 x 9 in.; 31 pages; illustrated. Ames, Iowa, Engineering Experiment Station, Iowa State College.

REPORT—STATE WATER PROBLEMS CONFERENCE, CALIFORNIA. Paper, 6 x 9 in.; 125 pages. Sacramento, Cal., State Printing Office. Findings and recommendations of the conference appointed under act of the California legislature to recommend "a unified state policy with reference to the irrigation, reclamation, water storage, flood control, municipalities and drainage, with due regard to the needs of water power, mining and navigation."

STEEL RAILWAY BRIDGES—DESIGNS AND WEIGHTS. By Edward C. Bilwirth, designing and contracting engineer, Pittsburgh-Des Moines Steel Company. Cloth, 9½ x 12½ in.; 185 pages; illustrated, including 105 full-page plates. New York, D. Van Nostrand Company. \$4 net.

ELEMENTS OF HYDRAULICS. By S. E. Slocum, B.E., Ph.D., professor of applied mathematics in the University of Cincinnati. Second edition, revised and enlarged. Cloth, 6 x 9 in.; 329 pages; illustrated. New York, McGraw-Hill Book Company, Inc. \$2.50 net.

HANDBOOK ON WOOD PRESERVATION. Cloth, 6 x 9 in.; 73 pages; illustrated. Baltimore, Md., American Wood Preservers' Association.

AWAKENING OF BUSINESS. By Edward N. Hurley, chairman of the Federal Trade Commission. Cloth, 5 x 8 in.; 240 pages. Garden City, N. Y., Doubleday, Page & Co. \$2 net.

THE ENGINEER IN PUBLIC SERVICE—Part 1. By Frederick E. Breithut. Bulletin 78, Bureau of Municipal Research. Paper, 6 x 9 in.; 71 pages; illustrated. New York, Bureau of Municipal Research. 75 cents.

THE OHIO-MICHIGAN BOUNDARY. VOLUME 1 OF FINAL REPORT, Ohio Co-operative Topographic Survey. By C. E. Sherman, C.E., inspector. Cloth, 6 x 9 in.; 115 pages; illustrated. Columbus, Ohio, Co-operative Topographic Survey.

This is the first of four volumes of the final report on the relocation of the Ohio-Michigan boundary line. Volume 2, entitled "Description of Surveying Marks and Monuments Used in Making the Topographic Survey of Ohio," will soon be issued.

BRIDGE MANUAL—STATE OF OREGON. Containing Standards, General Information and Instructions. Prepared under the direction of John H. Lewis, State Engineer. Paper, 11 x 7½ in.; 151 pages; illustrated. Salem, Ore., Office of State Highway Commission.

NEW IDEALS IN BUSINESS. By Ida M. Tarbell. Cloth, 5 x 7½ in.; 339 pages. New York, The Macmillan Company. \$1.75 net.

GEOGRAPHY OF THE UPPER ILLINOIS VALLEY. By Carl O. Sauer. Bulletin 27, State Geological Survey. Cloth, 7 x 10 in.; 208 pages; illustrated. Urbana, Ill., State Geological Survey, University of Illinois.

SELECT LAYERS FOR ROAD WORK. Bulletin 111, Office of Public Roads and Highways. Paper, 6 x 9 in.; 218 pages; illustrated. Washington, Government Printing Office.

VEGETATION, DEFORESTATION AND THE RATE-BASE. By C. E. Grubsky, Eng.D., and C. E. Grubsky, Jr., E.M. Cloth, 6 x 9 in.; 387 pages. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$4 net.

MODEL OF THE AMERICAN MANUFACTURERS' EXPORT ASSOCIATION by the Industrial Commission to France. W. W. Nichols, chairman. Cloth, 8 x 11 in.; 256 pages; illustrated. New York, American Manufacturers' Export Association. (Commented on in the editorial pages of this issue.)

Books Reviewed

Elements of Hydraulics

Author, S. E. Slocum, B.E., Ph.D., professor of applied mathematics at the University of Cincinnati. Second edition, revised and enlarged. Cloth, 6 x 9 in.; 329 pages; 221 illustrations. New York, McGraw-Hill Book Company, Inc. \$2.50 net.

REVIEWED BY A. G. HILLBERG
Hydraulic Engineer, New York City

This book, of which the second edition has now appeared, seems to have found its place as a textbook for students, as indicated by the quick sale of the first edition, which was reviewed in the Engineering Record of March 13, 1915, page 338. The book had then 294 pages and 210 illustrations, and some matter of importance had not been treated as fully as might be desired.

In the second edition the author has revised his text and added much of value. In Part I, "Pressure of Water," is added a chapter on strength of pipes under internal pressure. Only the stresses due to internal pressure are considered, and the treatise is based on the assumption that the diameter of the pipe is negligible when compared with the pressure head; or, in other words, that the pressure of the fluid is the same at the top of the pipe as at the bottom. This, of course, is never true, but for small pipes under relatively high pressure the difference is so small that its influence is negligible. For larger pipes the weight of the water contained in the pipe also creates moments in the shell, but the analysis of this problem evidently is too complicated, in the opinion of the author, to be included in a book treating the elements of hydraulics.

In the second part, "Flow of Water," the author has revised considerably the chapter dealing with weirs. Paragraphs on submerged weirs, triangular notch weirs and the Cippoletti weir have been added and the treatment in general made more rational. To the chapter on loss of head in pipes the author has added paragraphs dealing with exponential formulas, a diagram giving the loss in head, the discharge in second-feet, the velocity and diameter for wood-stave pipes, and treats the flow in cast-iron pipes, deterioration with age, and flow in steel pipes and concrete pipes. The chapter on the influence of bends and elbows on the flow has also been rewritten and much new matter added; as for instance, experiments by Williams, Hubbel and Fenkell, Schoder, Brightmore, Davis and Balch.

The following chapter, on enlargement of section, has been added to, and the application of the Bernoulli theorem to problems of this kind has been clearly shown. In the discussion on the hydraulic radius the use of the Kutter, Bazin and Williams and Hazen formulas to problems pertaining to the flow of water in pipes is explained. In the chapter on modern siphons the author shows not only American siphons, but also types representing the practice abroad, where sometimes water-wheels have siphonic intakes.

The old chapter on backwater has been eliminated entirely and new matter substituted. The methods now given are those used generally by engineers, and the complicated mathematical treatise often adopted by writers of textbooks, but seldom, if ever, used in practice, has been omitted.

The chapter on turbines and their appurtenances was unusually good in the first edition, but the author has nevertheless revised it and added much new matter. The paragraphs on water hammer have been rewritten and a chapter on surge tanks added. As in the former edition, the last pages are in the form of an appendix containing tabulated hydraulic data. Two new tables have been added, one on the discharge from woodstave pipe and the other on submerged weir coefficients, so that there are now 22 tables covering 35 pages.

Hydroelectric Power

Author, Lamar Lyndon. Volume 1. Hydraulic Development and Equipment; Volume 2. Electric Equipment and Transmission. Cloth, 6 x 9 in.; 499 pages and 360 pages respectively; illustrated. New York, McGraw-Hill Book Company, Inc. Volume 1, \$5 net; Volume 2, \$3.50 net.

REVIEWED BY DAVID R. COOPER

Designing Engineer, Power Construction Company,
Worcester, Mass.

Students and practising engineers interested in the design of hydroelectric-power plants will wish to add this book to their libraries. It constitutes a timely addition to engineering literature, coming when general interest in water power is being revived.

The work, as may be inferred from the title, is quite general in scope, covering both the hydraulic and electrical phases of design. Volume 1 is entitled "Hydraulic Development and Equipment," and Volume 2 is entitled "Electrical Equipment and Transmission." However, it should not be concluded that the two volumes are entirely independent of each other. As the author puts it in the preface to Volume 2, "this volume forms a companion to, and is, in fact, a continuation of Volume 1. There is no definite point of division between the two volumes, and this treatise was divided into two sections solely to make it less cumbersome and more convenient for reference." Volume 1 could certainly not be considered as complete in itself without a considerable part of Chapter 5 in Volume 2 on the design and testing of power stations.

On the whole, it may be said that the author's work is well done. In scope the book is excellent; it touches on almost all phases of plant design and defines the principles governing design very well. Naturally, some features into which the author has probably gone deepest in his own practice are treated more fully than other features that would be of equal or more interest to other engineers; however, the treatment of topics is very well balanced.

Mr. Lyndon follows one custom that might well be emulated by other authors. This consists of introducing mathematical discussions and formulas directly in connection with the solution of specific designing problems. Another noteworthy feature of the author's methods which is not so commendable is a very strong tendency to represent variable factors as having constant values. In numerous places he states fixed values for coefficients and definite limits of practice that are unfortunately not subject to such definiteness. Nevertheless the author's assumptions of positive values in many cases at least have the merit of constituting very good average values.

There are several noteworthy new features, including a discussion of the design of curved draft tubes and concrete scroll cases for vertical low-head turbines. A chapter is included on "Movable Crests for Dams." The author takes issue with some writers on upward pressures under dams, includes a so-called "exact formula" for computation of sections of a gravity dam and also condemns as uneconomical the general practice of using structural steel towers for transmission line supports instead of wooden or reinforced-concrete poles. He also advocates less exacting processes for the determination of stream flow.

A number of very good charts and diagrams are included. The illustrations are excellent, and the publishers have done their part well.

Water Supply

Author, William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute. Cloth, 6 x 9 in., 528 pages; illustrated. Fourth edition, rewritten. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$3.75 net.

REVIEWED BY WESTON E. FULLER

Consulting Engineer, Hazen, Whipple & Fuller, New York City

Professor Mason, in rewriting his well-known book, "Water Supply," for its fourth edition, has, while retaining the many excellent qualities of the earlier editions, added to and revised it so as to make the book a thoroughly modern treatise of water supply from the sanitary standpoint.

The grouping of the material into chapters is the same as in the earlier editions. Much data relating to recent progress in the art have been added and the book revised to meet the requirements of modern practice. The author has continued his excellent method of including a digest of the views of different authorities, with his own comments and explanations.

The book is exceptionally well arranged and illustrated. It is essentially one on water supply from the sanitary standpoint, and is not intended as a treatise on the other elements of water supply. Some data on the various types of purification works and the cost of the same are, however, included. The chapters on drinking water and disease, stored water, and the action of water upon metals are particularly useful.

When Will They Fall in Line?

The constitutions of Kansas, South Dakota, and Wyoming prohibit these states from participating in works of internal improvement, and consequently from issuing state-road bonds.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Canvas Envelope Makes Steel Cofferdam Tight Under 38-Foot Head

By H. W. STREULI
Schenectady, N. Y.

LEAKS in a single-line steel cofferdam, where the usual methods of applying fine material around the outside of the sheeting could not be used because of the proximity of a waterworks intake, were stopped by the writer with the use of a four-piece canvas envelope, the space between which and the sheeting was stuffed with cinders. The cofferdam was used in constructing a new intake and gatehouse for the Salem (Mass.) pumping station at Wenham Lake, North Beverly, Mass. The cofferdam was made of 50-ft. arch-web Lackawanna steel sheet piling, driven with a steam hammer during the month of March in 30 ft. of water.

The following month the lake rose to high-water mark, giving a total head of 38 ft. on the bottom of the dam. All the sheeting had to be driven through 7 ft. of coarse gravel and 5 ft. into the underlying sand and clay without any dredging on account of the closeness of the cofferdam to the old intake and pipe line, which was still supplying the city of Salem with water. Under the hard driving, made necessary by these conditions, the steel was considerably bent and twisted in spite of the care taken to prevent this. Naturally, severe leaks resulted, which had to be closed before the dam could be unwatered. The old intake and pipe line being within 10

ft. of one part of the dam, it was naturally out of the question to use ordinary methods of blanketing or puddling, or to dump any such material as cinders, sawdust or manure into the water around the dam.

A sufficient number of strips of heavy second-hand canvas, long enough to reach from a point 1 ft. above high water to the bed of the lake and leave 6 ft. to spare, were secured and sewed together to make four sides. To each of these sides a row of old brick was sewed with wires at the very bottom edge of the canvas. Another row of brick was sewed in the same way parallel to the first, but about 5 ft. above it. The top of the canvas was then fitted with short pieces of rope about 3 ft. apart. The two pieces for the sides of the dam were long enough to lap 6 ft. around each end of the dam, while the end pieces were made the exact length of the ends of the dam. The pieces were lowered

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"HINTS FOR THE CONTRACTOR."

separately so that when the bottom row of brick landed, it was parallel to and about 5 ft. away from the base of the steel. The top of the canvas was then draped in toward the steel so that the second row of brick would land near the sheeting, leaving the canvas hanging vertically a few inches away from the steel.

At each corner of the dam, two narrow 1-in. boards 38 ft. long were lowered vertically, one on the outside and the other on the inside with the double thickness of canvas between them, and nailed together by a diver, to hold the lap securely. The diver also inspected the bottom of the canvas and placed some additional ballast in the shape of sand bags.

LEAKAGE HANDLED BY 4-INCH PISTON PUMP

When the envelope was in place, the entire space between it and the steel was filled with screened soft coal cinders, rammed lightly as they were put in. The dam, on being unwatered with a 10-in. centrifugal pump, proved tight, the only leakage being through the bottom and through the portion of the steel sheeting which was below the bed of the lake in the seam of gravel. This leakage was handled throughout by a 4-in. piston pump. It could not be avoided, as it was impossible under the conditions to blanket the surrounding bottom of the lake with impervious material, or to dredge a trench around the cofferdam and backfill it with a mixture of clay and gravel.

After the completion of work inside the cofferdam, canvas was removed and found in excellent condition. The work described was carried out by the Bay State Dredging Company, of Boston, for which the writer was superintendent.



TWO ROWS OF BRICK SEWED TO BOTTOM OF CANVAS MADE FLAP LIE FLAT ON LAKE BED

One-Legged Skid Derricks

IN SINKING wood sheeted pits from 20 to 40 ft. deep for the foundations of the transmission-line towers of the Beach Bottom plant of the American Gas & Electric Company, described in the Jan. 27 issue of the Engineering Record, the one-legged derricks shown in the photograph proved very useful. Not requiring any elaborate track, they were easily moved, and brought the time and cost for installation on this work to a low figure. They were made over from standard traveler derricks, retaining the 20-ft. mast, 40-ft. boom, and the stiffleg beside which the hoist was mounted. The work of the other stiffleg is done by two guys, which are slacked off, taken in, or



DERRICK, UNLIKE MAN, MOVES MORE EASILY WITH ONE LEG THAN WITH TWO

moved to new anchorages, as the progress of the traveler requires.

The work is in charge of H. B. Kelsey, superintendent, under George R. Johnson, district manager for the Foundation Company, contractor for the power plant.

Floor Plans Simply Marked Show When to Strip Building Forms

IN ONE CORNER of the field office of the Turner Construction Company at the plant in Hoboken, N. J., described in last week's issue, hung two large drawing boards hinged about one edge to form a rack of the style approved by art museums for displaying photographs. Instead of being covered with works of art, however, the sides of these boards were filled with diagrams of the different floors in the two units of the building under construction. Each floor plan was ruled off in small irregular blocks corresponding to the units in which the forms were erected and concreted. As the forms were erected for each of these blocks, the corresponding area on the proper floor plan was roughly hatched in one direction with a red crayon. As the concrete was poured in each section, the date of concreting was stamped in the corresponding section on the floor diagram with a rubber dater.

In this way the superintendent had a visible and easily consulted record of the progress of the entire work. The system made it possible to tell at a glance and with certainty what parts of each floor could be stripped as the work progressed. The diagrams thus afforded a more reliable and much more easily kept

record than could be secured with any system of written reports.

The work kept track of in this way was carried out for the Hoboken Land & Improvement Company by the Turner Construction Company, for which Albert Larsen was superintendent.

First Aid as It Ought to Be, But Seldom Is

"TAKE him to the office!"
"But his leg's broke."

"Makes no difference. The doc can't walk them ties across the bridge and climb down that bank. Come on, fellows, pick him up."

Moving a man with broken bones before the parts have been properly secured is not the only offense perpetrated in the name of first aid after an accident on construction work. A few of the mistaken attentions that seem to be second nature with many construction men who have never been given definite instruction in first aid treatment have been aptly summed up by Dr. W. N. Lipscomb, field representative of the American Red Cross, who has been engaged in organizing first-aid work among the mills of members of the West Coast Lumbermen's Association in Oregon and Washington. Some of these pointers, which while known to every insurance physician cannot be repeated too often for the benefit of the layman, are as follows:

Never fail to give attention to a wound, no matter how small.

DON'T DRAG CLOTHING OVER WOUNDS

Never drag clothing over a wound, but cut or pull it away carefully.

Never put fingers or anything else into a wound for any purpose, and never wash out a wound with water, which may carry bacteria, and is therefore dangerous.

If proper first-aid material is not at hand, it is safer to expose a wound to the open air than to put a handkerchief or other material on it. When a doctor is not immediately available, apply one-half strength tincture of iodine to wounds and for one inch around the margin.

In case of a fracture, do not move a man even a few feet before properly securing the broken bones in place. To violate this rule may cause a much worse condition. Do not poke around or otherwise handle the injured part unnecessarily in seeking to locate the broken spot. Do not let the patient dictate some favorite method of treatment.

TREAT OPEN WOUNDS FIRST

If an open wound exists, treat it first. Then, unless a broken bone is protruding, straighten the limb gently and hold it in position while another person applies and bandages splints, which should be carefully padded with any soft material at hand. The leg can be straightened by grasping the toes with one hand and the back of the heel with the other, while the upper arm or forearm can be handled by grasping the shoulder or elbow or wrist and elbow, as the case may be. If the end of a bone is protruding, do not "wash" it or attempt to replace it. On the contrary, put a sterilized-gauze pad under the bone before applying the splints to prevent its returning to place.

If it should be necessary to raise the part in order to apply the bandages, do not do this, but slide the bandages underneath, using a thin, flat stick. The bandages should be tied outside the splints with knots, but should not be drawn too tightly.

It is always necessary to watch for and treat shock by lowering the head, loosening the clothing, keeping the person warm and handling him as gently and as little as possible.

Raise United States River Steamer by Pumping Out Hull

By W. E. DUNSCOMBE

Submarine Diver, St. Louis, Mo.

THE United States stern-wheel steel-hull river steamer "Nauvoo," which sank early in the year in Quincy Bay, Quincy, Ill., was recently raised by the writer without erecting bulkheads all around the deck. It is believed that this is the first time a river steamer of this class has been raised without resort to such a cofferdam. When the boat was raised, the temperature was 6 deg. below zero, and it was necessary to cut through the ice before the writer was able to do the necessary diving.

It was possible to close off the steel hull into several watertight compartments, which were pumped out with a 6-in. centrifugal pump, assisted by two 3-in. and two 4-in. steam siphons. The work was carried on from the sister ship of the sunken boat, the U. S. steamer "Muscatine," whose boilers supplied steam for operating the pumps. It took only 6 hours to empty the compartments in the hull of water and bring the vessel to the surface.

The work of raising the vessel was carried out by the writer for the Rock Island district office of the U. S. Engineer Corps, Major George M. Hoffman being the officer in charge of the district.

Revolving Mast Carries Spout for Concreting Circular Basins

By C. F. LAMBERT

Kansas City, Mo.

IN CONCRETING two circular concrete settling basins for the municipal waterworks of Brownwood, Tex., a central concrete plant was used for both basins from which concrete was distributed to the walls through a revolving chute supported from a ginpole set in turn at the center of each basin. The installation, which proved very successful, is plainly shown in the photograph.

Each of these basins has an inside diameter of 105 ft., with thin walls 10 ft. high. The walls, which are entirely above ground, are 6 in. thick at the top and 8 in. at the bottom. The basins are floored with 6 in. of concrete, sloped toward the center for drainage. At this point a 6-in. cast elbow connecting with the drain pipe is set. This elbow was placed first in each basin and used as a step for the ginpole. The pole was fastened by a guy spider and pin at the top, which left it free to revolve. Concrete was spouted from the central tower to a wood hopper built around the pole at the proper height, from which a second wood chute, supported from the pole as a boom, distributed it to

the walls. An opening in the chute about half way down from which a vertical spout could be hung permitted concreting the floor without a return spout. When the first basin was completed, the pole and chutes were moved over to the second basin.

The obvious economy of this method of distributing the concrete could be taken advantage of in this sort of construction, where thin walls above ground had to be made absolutely watertight, because of the use of hydrated lime in the concrete. This was mixed with 1 part cement to 6 parts aggregate, the aggregate being a mixture of sand and gravel, which gave the pro-



CHUTE AND MAST REVOLVE TOGETHER

portion of an ordinary 1:2:4 mix. The hydrated lime used was about 10 or 12 per cent by volume of the cement. The 450 yd. of this concrete which was mixed with hydrated lime flowed very freely through the chutes, did not require an undue amount of water, and did not separate, and produced a smooth surface against the forms. The resulting construction was absolutely watertight. The basins were designed by the writer.

Spontaneous Ignition of Charcoal

Spontaneous ignition of wood, according to a paper read by Frederick J. Hoxie at the annual meeting of the American Society of Mechanical Engineers, is undoubtedly intimately associated with spontaneous ignition of charcoal. In dwellings and factories many of the fires originate in the woodwork near steam pipes or other heating appliances which are kept at temperatures far below the ignition point of wood and are the result of spontaneous ignition of charcoal formed by slow combustion over extended periods of time.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Debate Depreciation and Land at Valuation Hearing

Valuation Division Defends Omission of Reproduction Cost of Land—Discuss Joint Property

Depreciation and the treatment of land were the two big subjects that occupied most of the last four days of the valuation hearing in Washington last week, an account of the first two days of which appeared in last week's issue, page 201. In the Wednesday session, however, there was considerable debate over railroad crossings and also over industry tracks, which are two phases of the many-sided and perplexing problem of joint property—that is, property owned wholly or in part, or used wholly or in part, by other than the carrier under valuation. When the hearing adjourned Saturday noon, only the first group of issues, those not involving the taking of testimony, had been disposed of. The program is that examiners be appointed to take the testimony locally, and that the argument before the commission be resumed the week beginning March 19.

Assessments for Public Improvements

The first subject discussed Wednesday, Jan. 31, the third day of the hearing, was that of assessments for public improvements. W. G. Brantley for the A. B. & A. answered the claim of the Division of Valuation that these amounts are included in the added value of the lands by the contention that the carrier was entitled to that added value regardless of how it was acquired, and was in addition entitled to actual costs incurred. C. F. Newman for the Division of Valuation held that the theory upon which public assessments are made or allowed is that they enhance the value of the property. He held also that this has proved true in fact as well as in law, and that the carrier's theory would result in duplication. Thomas W. Hulme, vice-chairman of the Presidents' Conference Committee, suggested that assessments do not always increase value immediately, but often require heavy private expenditures to produce that value.

Railroad Crossings

Under the head of railroad crossings consideration was given to both grade crossings and separated grades. Mr. Brantley claimed for the A. B. & A. in reproduction the entire cost of either type of crossing where his road, as the junior, had been obliged to pay the entire cost.

Director Charles A. Prouty of the

Gen. George W. Goethals Opens Consulting Offices

Gen. George W. Goethals has opened offices in New York City and will engage in a general consulting practice in civil, electrical, mechanical and hydraulic engineering. His associates, who, with the exception of George M. Wells, have not as yet been announced, will be experienced specialists in their particular lines. Mr. Wells has just resigned as resident engineer in charge, Division of Building Construction, Panama Canal. The firm will give special attention to examinations and reports on canals, harbors, drydocks, terminals, dams, water-power development, water supply, purification of tropical waters, refrigeration, reinforced-concrete structures, organizations, management and public utilities. The offices are at 43 Exchange Place, New York City.

St. Paul to Electrify Over Cascade Mountains

Electrification of the Chicago, Milwaukee & St. Paul Railway, already completed through the Rocky and Belt Mountains and nearly finished through the Bitter Root range, is to be extended over the Cascade Mountains. Announcement of the plans for this project has been made by C. A. Goodnow, assistant to the president of the St. Paul System. Four hundred and sixteen miles of the railroad's Puget Sound line is now being operated electrically and the work on 24 miles from East Portal to Avery, Idaho, is to be finished this month. The completion of this section of the work will complete the original electrification program of 440 miles. While it has not been definitely decided how soon the electrification over the Cascade Mountains to the Coast will be undertaken, it has been announced that the surveys are now under way.

Engineers Present Arguments for Nitric-Acid Plant

The contention that Muscle Shoals on the Tennessee River constitutes the best location for the proposed \$20,000,000 government nitric-acid plant is set forth in a lithographed book placed before President Wilson in Washington, Jan. 22, by the Muscle Shoals Association. The book was prepared by the Nashville section of the Engineering Association of the South. The arguments put forward are embellished with colored photographs of scenes about Muscle Shoals, which lies 75 miles southwest of Nashville. There are numerous maps.

National Commerce Chamber Holds Fifth Meeting

Takes Action on Revenue Bill, Daylight Saving and Statistics of Inland Waterway Traffic

The Chamber of Commerce of the U. S. A., with more than 1200 delegates, representing 300,000 business men, in attendance, met in Washington, D. C., Jan. 31 and Feb. 1 and 2, and among other things took a strong position on the pending revenue bill, indorsed preparedness, the Webb bill and daylight saving; reaffirmed its stand in favor of a budget system for the national government and, in view of the present crisis, pledged the business interests of the country to support the President in any eventuality. One of the notable addresses of the meeting was that on industrial relations, by Harry A. Wheeler, first president of the National chamber. It is reprinted elsewhere in this issue. Of special interest to civil engineers was the passage of a resolution calling upon the government to collect with its own force statistics regarding the use made of inland waterways, such statistics to be used as a basis for determining the advisability of improving these waterways.

Chamber Financially Sound

The address of the president, R. Goodwyn Rhett of Charleston, S. C., showed that the chamber was not only in sound condition financially, but that it has had a great growth in the last year. More than 200 organization members and 2750 individual members have been added to the rolls, while the reaching of the limitation set on the number of individual members, 5000, suggested amendments to the by-laws. These amendments to the by-laws, brought up at the main business meeting of the session, were passed. They provide for two new classes of membership—associate and endowment. Associate members may be persons, firms or corporations, paying dues of \$100 or multiples thereof per annum, and who are entitled to appoint a representative for each \$25 paid. Endowment members are those who have contributed \$500 or more, not including annual dues. These contributions are to go into an endowment fund, which, when the board of directors deems advisable, will be used to acquire a home for the chamber. Meanwhile the income from this fund may be used, if necessary, to defray the expenses of the chamber. Both amendments were passed.

After the War

One whole session, addressed by Secretary Redfield of the Department of Commerce; Dr. Leo S. Rowe, secretary

of the International High Commission; Wallace D. Simmons of St. Louis, and Richard H. Waldo of New York, was devoted to conditions after the war and preparations therefor. Moreover, the report of the committee on the Department of Commerce, of which A. W. Shaw is chairman, dealt with this subject and proposed certain new activities for the department. Says the report:

"If there is one thing more likely than any other to defeat us in the world competition after the war it is this: That in the very nature of the case we are now being reminded constantly of the strong points in our position, while our three greatest foreign competitors are being reminded constantly of the weakness in theirs, i.e., that home efficiency is the key to prosperity."

After-the-War Problem

"It should help us to remember," the report adds, "that the 'after-the-war' problem, whether we look at it from the standpoint of foreign or domestic trade, is at the bottom just a problem in ordinary home efficiency. If we as American business men, individually and collectively, can produce and distribute with as little waste of materials, man-power and opportunity, as our foreign competitors, we shall get on comfortably. If we do not, our interests must sooner or later suffer. We may pile up wealth and gold reserves, establish scientific tariffs, negotiate the best of commercial treaties, carry on the most vigorous foreign trade propaganda, legalize combinations for exporting, we may do a hundred wise accessory things like these, but unless they are backed up by a business fundamentally as efficient as that of our competitors, they can give us no lasting security."

New Functions for Commerce Department

The report proposes the addition of four closely related new functions in the Department of Commerce, which would put it into a relation of everyday helpfulness to the business men, corresponding roughly to that which the Department of Agriculture now holds to farmers.

First, the department should find out what it costs to do business in the United States. As the department found out enough such facts to proceed with, it should, as its second new function, deduce from them sets of reasonably attainable standards, for the various items of expense in the various lines of business. The third new function would be to tell the manufacturer and business man, that is, to circulate information concerning the methods of the more efficient. The fourth new function would be the working out of still better methods than the department found in use in any actual business.

At the railroad session Walker D. Hines, chairman of the board of directors of the Atchison, Topeka & Santa Fe Railway, predicted that if

Congress adjourns without passing the pending railroad disputes measure, there will be a strike of the railroad brotherhoods or at least the threat of a strike. He believed that the strike will come whether the Supreme Court declares the law constitutional or not. If the law is held constitutional, there will be so many adjustments to be made between the railroads and the employee that conflict is sure to result. [It may be mentioned that this prediction was made before the break in relations with Germany.]

The vote was announced on the referendum relating to the railroad problem. On the question of indorsing the measure forbidding a strike until the results of an investigation of the situation were made public, the vote stood 1226½ in favor and 18½ against. On the question asking if on any investigating board the employees and employers should have equal representation and the public as having the paramount interest, a majority, 1166½ votes were cast for and 59½ against the proposal. Finally it was voted 1171 to 70 that the Interstate Commerce Commission should establish a statistical division to study and compile statistics relating to wages and conditions of service, the records and statistics to be available to investigating boards.

Immigration

The committee on immigration reported the results of an inquiry touching on immigration after the war. The questions were sent to railroad passenger agents. The questions and returns are as follows: *Question A:* Are immigrants in America saving money to bring over aliens? *Answer:* Of the 934 replies received, a certain number are inclusive or vague, but the great majority are definite, and of the latter 71.6 per cent indicate that savings are being accumulated in considerable volume for this purpose, while 28.4 per cent report that among the people with whom they are in touch there is no movement in this direction. *Question B:* Does personal correspondence from Europe indicate a movement to this country? *Answer:* Of those replies giving any definite indications on the subject, 52.4 per cent indicate that it will be large and 47.6 per cent that it will be small. *Question C:* Will such immigration as does occur be from the farms or from the factories? *Answer:* While about one-third were unable to give any information on this subject, those who did report indicate that 69.8 per cent of the immigration will be from the farms and 30.2 per cent from the factories. *Question D:* After the war is over, will there be any considerable permanent emigration from this country to Europe? Of the replies 21.8 per cent report that there will be a large permanent emigration; 78.2 per cent report that it will be small. *Question E:* How great will be the movement of those going back to Europe temporarily after the war and who will return after a short visit? *Answer:* Of the replies, 57.5 per cent report that

it will be large; 42.5 per cent that it will be small.

Resolutions

The main resolution introduced related to preparedness and the pending revenue bill. It created considerable discussion but finally carried by much more than a two-thirds majority, at least so far as could be judged by the viva voce vote. The resolution approved of the program of preparedness, as indorsed by the chamber's referendum and by various resolutions, and also pledged the support of the chamber to any just and reasonable taxation to support preparedness. The resolution protested against the inequitable and discriminatory taxation of the pending revenue bill providing for a tax on corporations and copartnerships, and finally, declared that the business men of the country would approve of any bill drawn along the lines of fairness "so that every citizen would pay his just share of the tax."

Statistics

Besides the resolution just referred to and those briefly mentioned in the introductory paragraph of this account, resolutions were adopted covering the following subjects:

The collection by the government itself of statistics regarding traffic on inland waterways, said statistics to be used in determining the advisability of improving these channels, and the creation of a salaried commission, composed of economists and statisticians, with a term of five years, to study the census and statistical machinery of the United States, in order to determine its efficiency and recommend changes and improvements so as to secure the best results from the government's statistical work.

Colfax-Larimer Viaduct in Denver Opened to Traffic

One of the largest viaducts in the country, the Colfax-Larimer X-shaped reinforced concrete structure in Denver, was opened Jan. 18. Including all its branches, it is 8479 ft. long, and varies in width from 36 to 68¼ ft. The cost was approximately \$2 per square foot and \$100 per linear foot, and is borne jointly by the city, tramway company and railroads. The structure, the second of its kind, consists of suspended spans alternate between sets of two cantilever towers—a form of articulated slab-and-girder construction which provides for settlement as well as expansion. Photographs of the structure were shown in Engineering Record, Aug. 28, 1915, page 263, and a description of the suspension detail was given on Oct. 17, 1914, page 428. H. S. Crocker, consulting engineer for all parties concerned, made the designs and supervised the construction. The general contractors were the C. S. Lambie Company, the C. P. Allen General Contracting Company and the Denver-Pueblo Construction Company.

Debate Depreciation and Land at Valuation Hearing

CONTINUED FROM PAGE 239

Division of Valuation admitted that the problem had given the division much trouble, and that he was not wholly in accord with the course that has been adopted on the recommendation of the advisory and engineering boards. The plan adopted, however, was to get the carriers concerned to agree, if possible, as to the division of ownership. Failing in this, an arbitrary division was made on the basis of use and necessity. Thus, grade crossings would be divided equally, interlocking would be divided on the basis of use, as determined mainly by the number of levers used by each road, while in the case of undercrossings the higher road, being the one dependent upon the bridge, would be allowed the full cost.

It was the aim of the division to record all of the facts, and Mr. Prouty admitted that it would be necessary in some manner or other ultimately to allow the carrier all it had paid, even to the extent of extra money paid for the privilege of crossing. P. J. Farrell, solicitor for the division, held that this was the only feasible treatment of the problem, the only one that would avoid duplication.

Pierce Butler, for the Texas Midland, argued that in apparently making the whole allowance to both carriers there was no duplication. In the case of the undercrossing he held that the road using the bridge owned it as actual property, while the other road, if the junior, had paid the cost of the bridge for the right to cross. He held that every inch used by a carrier as right-of-way must figure in reproduction cost, and that the apparent duplication arose from doubled intensity of use.

Industry Tracks

Discussion of the general subject of joint or restricted use was continued under the head of industry tracks. The division's view, as voiced by Director Prouty, is that an industry track is a plant facility of the industry, and is not used for common-carrier purposes. The division, therefore, allows the carrier only whatever it could remove on termination of the contract between industry and carrier. The land occupied by industry tracks is allowed only when the carrier holds indefeasible title thereto, the test being whether or not the industry could interrupt the title of the carrier.

Mr. Butler contended that industry tracks were part of the terminals of the carrier, and that by relieving the traffic on other tracks for more general use they were clearly to be classed as for common-carrier purposes. This was substantiated, he said, by the car-spotting decision, the ability of the commission to fix rates for industries using the tracks, and by the right to condemn right-of-way to a single industry.

The contention of the carriers in all

of these matters pertaining to joint property is that the division has changed the phrase "owned or used" in the valuation acts to "owned and used."

Depreciation

Mr. Brantley's view of depreciation was similar to that expressed by him at previous hearings, that on a road properly maintained there is no depreciation, that to estimate it on the basis of life tables applied to individual units is to indulge in mere speculation, that to deduct it is to write off a large part of the value of the carrier, and that the meaning of the Valuation Act is that deferred maintenance only should be recorded. Pressed by Commissioner Clements for a definition of a proper standard of maintenance, he said he could get plenty of experts to determine it. To Director Prouty's remark that no two of them would guess alike, he replied that no two of the division's field men would guess alike as to the remaining life of a car. In fact, he thought the same man would not guess the same car alike twice on different days. He thought there should be a joint board of the division and the carrier to determine proper standards of maintenance, and that the depreciation would be what it would cost to bring the property up to that standard.

What the Law Requires

Comments by several of the commissioners suggested their belief that any writing off of value could result only from the use made of the figure reproduction cost less depreciation, and not from the mere recording of it, which they appear to think is required by the Valuation Act. Director Prouty voiced the same view. He held that if the carriers insisted that there was no depreciation, they were likely to be confronted at a later date with arguments against allowance for depreciation in the earnings. He thought that examination of the facts would determine whether or not writing off depreciation would be confiscation. In the case of the A. B. & A. he admitted that it would be, but he stated that there were other cases where the depreciation had been much more than made good by excessive earnings. Both kinds of cases, he thought, must be dealt with.

The function of the division, he held, was simply to determine the number of service units which had been used up. The division was using the straight-line basis, which, he said, was too favorable to the carriers. They would ultimately, therefore, have to account for the interest.

Contrasting with the suggestions of the commissioners and the director that depreciation was to be found because the act required it and that this did not imply that it must be deducted to determine the rate base, Mr. Farrell read from the Knoxville water decision in support of the view that the deduction is to be made to determine the rate base. C. B. Aitchison for the states, following the same line of thought, read from the long list of decisions presented a year ago by the state commissions.

Mr. Butler supported Mr. Brantley's view, developing the idea that with a carrier of size renewals would be uniform from year to year, and would be accomplished by the replacement method, without the need for any depreciation fund. Answering Commissioner Daniels' query as to whether Congress intended the recording of two identical columns—reproduction cost new and reproduction cost less depreciation—for well maintained roads, Mr. Butler pointed out that the division had the same figures in both for land, grading and engineering.

The straight-line basis of depreciation, Mr. Butler thought, was entirely wrong, being based on the erroneous assumption of the division that all service units of a given item are equal value. The effect, he said, was especially noticeable in such long-lived items as masonry, in which, to offset an annual reduction in value of \$1, by a method ignoring interest, the carrier would probably be allowed the much smaller amount that would produce \$1 at the theoretical end of life of the item.

Other Lines of Investigation Suggested

Mr. Hulme asked that the division be instructed to pursue three lines of investigation, to determine (1) what deterioration took place during the construction and development periods, (2) to what extent there has been deferred maintenance and (3) to what extent inadequacy and obsolescence had bearing on the mortality tables used by the division. Director Prouty thought the second and third could not be answered, and Mr. Farrell thought the same of the first in the absence of a definition of the development period.

At this juncture the question was raised whether such general questions as whether or not original cost should be reported, and whether or not there are other values and elements of value, and whether or not there should be an ultimate signing of value, should be argued in full in the case of the Texas Midland Railroad. Mr. Butler stated that he did not think this should be done, as the Texas Midland could not afford to prepare the case well enough for a satisfactory test. Director Prouty agreed that the Kansas City Southern case, which is scheduled for argument the week of March 19, would present a much better test case. The division will not, however, have all its data available on this road before July.

Treatment of Land

Four issues were combined in the discussion of land, which consumed the last two days of the hearing. Practically the whole debate hinged on the interpretation of the Minnesota rate decision, all sides using it repeatedly to support their contentions.

Mr. Brantley, following the argument previously presented by the carriers, to which he referred, held that the decision in question established the cost to condemn the land as the proper basis of reproduction cost, and barred out only the additional value because of its rail-

road use. And the latter figure, he contended, was allowable as present value. He held that the division must give reproduction cost to comply with the law, and that its figure "present value," being only the average acreage value, was not present value at all, and was a worthless figure. He contended that it was pure conjecture, and unreasonable, to assume that acquisition cost once paid could be avoided in reproduction.

Impossible by Law

The division, on the other hand, held that cost of acquisition had not been determined both because it could not be done and the act could not require the impossible, and because the figure would be useless if obtainable. Questioned by Commissioner Clements, who appeared unconvinced of the impossibility of obtaining the figure and of the permissibility of omitting it if obtainable, even though useless, Mr. Farrell quoted an oft-repeated passage of the Minnesota decision to prove its impossibility. He went further, and urged the exclusion of evidence from the carriers to show what land would cost now, if introduced to prove the possibility of determining the impossible.

Mr. Butler stated that prior to the passage of the valuation act the general interpretation of the reproduction cost of land had been that of the carriers. He contended that the language of the valuation act was plain in calling for this figure, and quoted from the briefs presented by the state commissioners a year ago to show that they believed this to be the mandate of the act, which they thought would have been worded differently if it had been passed after instead of before the Minnesota decision. Mr. Butler held that the law must be obeyed.

The State's View

The Minnesota decision was pressed into service a third time by A. E. Helm, speaking for the state commission, who interpreted the familiar passages to mean that reproduction cost of everything—land, grading and all other physical plant—was definitely rejected by the commission, thus establishing original cost at the proper basis.

C. E. Elmquist, for the State of Minnesota, supplemented this thought by presenting again his theory of instantaneous reproduction, which is that, because of the impossibility of imagining the non-existence of the railroad with everything else remaining undisturbed, reproduction must mean simply the application of reasonable unit prices to the existing quantities. Taking one of the tentative valuations, item for item, he read the amounts, computed by his engineer, that he thought should be deducted from the division's reproduction cost new. They covered, among other things, clearing and grubbing, shrinkage, subsidence, hidden quantities, temporary trestles, hauling by teams and wastage, inspection and rehandling of materials of any sort.

Director Prouty expressed doubt as to the value of such an estimate and Com-

missioner Hall asked whether there was any element of fiction in imagining the building of a railroad overnight. The carriers, however, seemed willing to let the argument stand on its own merit.

The one other argument on a subject of land was novel only because of its author—the representative of the four railway brotherhoods. The justification of his appearance was that he represented annual wages equivalent to the interest on \$30,000,000,000, as compared with a railway capitalization of \$21,000,000,000. His argument was the agency theory, that the railroads owned no land, their charters denying them that privilege even though they held fee-simple deeds, and that therefore no unearned increment could be any part of their value for rate-making purposes.

As previously mentioned, argument is to be resumed March 19, testimony having in the meantime been presented locally to examiners to be appointed for the purpose.

National Commerce Members Sing at Smoker

Sung at the smoker of the National Chamber of Commerce last week at Washington, D. C.

TRAMP! TRAMP! TRAMP!

Conservation is the cry, cost of living is too high,

So we're going to build the Great Falls power dam.

Free electric lighting scheme,

Three-cent fare, a happy dream!

And we'll charge up all the bills to Uncle Sam.

Chorus:

Dam, dam, dam the old Potomac

Where her waters rush and foam.

Talk about the River Rhine—

They have nothing half so fine;

We've a dam-site better here at home!

Falsework for Concrete Bridge in Spokane Collapses

Late on Tuesday, Feb. 6, the falsework of the new concrete bridge being erected over the Spokane River at Post Street, Spokane, Wash., collapsed. Only six of the twenty-five men on the work were accounted for at midnight. The wrecked falsework caused the river to back up and made rescue work difficult. City Engineer Morton Macartney stated Tuesday evening that the reason for the collapse was unknown. A full investigation will probably be made to fix responsibility.

New England Waterworks Men Meet Feb. 14

New England Waterworks Association will hold its meeting Feb. 14 at Boston. Frank Winsor, chief engineer of the Water Supply Board, Providence, R. I., will speak on the water supply of Providence. Forestry, in its relation to public water supplies, will be discussed by Prof. J. W. Toumey, director of the forestry school at Yale University.

Court Holds Flood Plans for Columbus Confiscatory

City Engineer Submits Modified Plans for Channel Improvements When First Plan Is Rejected

Flood-conservancy matters at Columbus, Ohio, are at a standstill. By a decision rendered Jan. 9, noted in these columns recently, the court held that the official plan, if assessed against the flood district in Columbus and Franklin County, would be confiscatory of the property. In deciding this question the court assumed for the purpose of the hearing that the plans are efficient and adequate and would afford the protection claimed for them by the engineers, Alvord & Burdick, who prepared them. No clew is given in the 4-page decision as to why the court should have reached such a decision, nor does it give any measuring stick by which an opinion might be formed as to what expenditure would be confiscatory and what would not be.

Modified Plan in View

Henry Maetzel, city engineer submitted a report Jan. 18 to the city council embodying two channel-improvement projects costing \$3,500,000 and \$4,500,000 exclusive of bridge change, to accommodate floods of 100,000 and 80,000 sec.-ft. The 1913 flood was 130,000 sec.-ft. Mr. Maetzel pointed out the inadequacy of the channels for adequate protection and strongly urged the construction of the Dublin dam in addition, which would just about safely protect against a recurrence of the 1913 flood.

This is the modified plan the conservancy district had in view; but competent engineers state that from a general conservancy standpoint it has no merit, for under it Columbus and Franklin County would be paying fully as much as under the official plan, should the cost of the latter be distributed over the whole benefited territory, from Delaware to Chillicothe. Furthermore, the protection is not as great, for the official plan provided for a flood 45 per cent in excess of that of 1913. As revised, however, the plan would be less burdensome upon the flooded district in Columbus, provided a way could be found for financing the channel improvements in Columbus with the \$3,500,000 bond issue already voted, leaving only the dam to be assessed against the flooded district.

Propose New Outer Lane Driveway Over Chicago River

An outer driveway connection between the north and south sides in Chicago at the mouth of the Chicago River is contemplated in an ordinance introduced in the City Council Jan. 31. The proposed drive would connect Grant Park with the municipal pier by a monumental bridge over the mouth of the river. The cost is estimated at \$1,500,000, and it is proposed that the expense be defrayed equally by the Lincoln Park and South Park boards.

French Buy American Construction Plant

Large Export Firm to Develop Demand That May Greatly Increase American Output

American manufacturers of concrete machinery, hoisting engines, excavating tools and other construction plant may find Europe, and especially France, Russia and Italy, markets which will justify a large increase in the capacity of their plants, according to Thomas Garrett, manager of the machinery department of Gaston, Williams & Wigmore, Inc. According to this firm, which has for some time been carrying on a large business in American manufactures and machinery with all parts of the world, France is likely to develop into an extraordinary market for such tools. With a population practically two-fifths that of the United States, and nearly one-half of which has heretofore been engaged in or supported by agriculture, France has up to the present carried out practically all of her public works without any of the tools developed in America for doing such work.

First Concrete Spouting Plant Shipped

Indeed, the first concrete spouting plant for building construction ever seen in France, so far as can be ascertained, is one which the corporation mentioned shipped to a French building contractor last week. As pointed out by Mr. Garrett, the population of the United States is so much smaller in proportion to the area developed than in European countries that the construction work carried on here is much more extensive in proportion to the population than is the case with any country in Europe, perhaps including even Germany. Hence the more advanced development in the United States of construction machinery. The war, however, has put a premium on all sorts of machinery that saves hand labor.

While in most European countries this condition has so far resulted in a demand for equipment to manufacture war supplies, it is expected after the war to result in a similar demand for the tools used in carrying out construction work. In fact, construction work is already under way in France on an extended scale because of peculiar conditions. With the larger part of its manufacturing territory, including most of its coal mines, in the hands of an invader, France has been faced with a situation in which it was necessary to carry out a great deal of industrial construction, and to develop the water-power resources of the country in order to lessen the seriousness of the loss of the larger part of the country's fuel supply. Moreover, extensive port and harbor improvements are under way or projected.

Construction Department in Charge of Noted French Engineer

Both on this account, and because France is more readily accessible to the

corporation mentioned, which owns and operates a fleet of 14 vessels between European and American ports, it was decided to develop a European market for American construction machinery first from Paris, where the French company of Gaston, Williams & Wigmore, Inc., has its offices at No. 5 Rue Daunaw. The construction department just established for this purpose has been put in charge of H. G. Harms, a French engineer who has been connected with many important public works in that country and who recently spent five years in the United States.

The present plans of the company are to make arrangements with American manufacturers of contractors' equipment for the supply of this equipment as it is sold abroad, the American firms being paid when the machinery is shipped from their factories, and the export firm collecting from the French consignees. Necessary repair parts for the lines of equipment handled will probably be carried in Paris, and it is expected that the demand will develop to a point where it will prove profitable to establish factories for assembling some of the equipment abroad. American workmen and construction men will be required at first to show the French how to use these tools.

Gasoline or Electric Drive Preferred

Electrically driven equipment, or cranes, concrete mixers and hoists operated by gasoline engines are preferred to steam equipment in France, according to Mr. Garrett. Although gasoline is more expensive there than in the United States, it appears to be more desirable as a source of energy than coal, and is likely to be employed where electric current is not obtainable. It is expected that the market will prove a profitable one from the start, in view of the many inquiries which this company has already received both from French contractors and from French capitalists who expect to undertake construction work. Many of these inquiries come in the form of letters to which advertisements cut from American engineering publications are pinned.

While it is impossible to predict at present to what extent Germany's new submarine campaign will interfere with freight service between this country and Europe, neither it nor the liability of the United States' participating in the war is expected to have any unfavorable influence on the enterprise outlined. On the contrary, it is believed that the entry of this country into the conflict would, if anything, foster closer relations and make the task of introducing American products abroad an easier one.

Round-Table Talks to Feature Indiana Sanitary Meeting

Round-table discussion at each of the four business sessions of the Indiana Sanitary and Water Supply Association are to be a feature of the convention to be held in Indianapolis Feb. 14 and 15.

What Engineers and Contractors Are Doing

ARTHUR M. PORTER has resigned as city engineer of Redwood City, Cal., and has been succeeded by C. L. Dimmit.

T. MOOTE has resigned his position with the Illinois Central Railroad to enter the employ of the Standard Oil Company of Indiana, at Whiting, Ind. Mr. Moote, a graduate of the University of Illinois, class of 1916, is also a graduate of the Oklahoma Agricultural and Mechanical College, class of 1910. From 1910 to 1911 he was with the Santa Fé system in Texas. For the next three years he was engaged in mountain railway work in South America with the Antofagasta & Bolivia Railway.

HARRY N. JENKS, recently employed to report on the sanitary precautions to be observed and watershed regulations to be formulated in the Mount Tamalpais region in constructing the new \$3,000,000 water supply of the Marin Water District, California, has been retained for two years as sanitary engineer with the Burma Mines, Ltd., Namtu, Northern Shan States, Burma, India. Mr. Jenks' work will include many phases of tropical sanitation as well as general engineering work. Under Prof. Charles Gilman Hyde he assisted in the preparation of the report on possible sources of water supply for the city of Sacramento.

JOHN D. MATTISON is with the Sinclair-Cudahy Pipe Line Company, drafting department, Tulsa, Okla. From the time of his graduation from the University of Illinois in 1915 to the first of this year Mr. Mattison was employed as junior engineer with the Illinois State Highway Department.

E. KEMPER CARTER has resigned his position of city engineer and superintendent of waterworks, Liberty, Mo., to represent the Standard Asphalt & Rubber Company, of Chicago, in the territory of Missouri, Iowa, Kansas and Nebraska, with headquarters at Liberty. Mr. Carter has been with the city of Liberty four years, going there in 1913 from St. Louis, where he was with the Southwestern Bell Telephone & Telegraph System. Previous to that time he was assistant city engineer of St. Joseph, Mo. He is a graduate of the University of Missouri.

NATHANIEL S. THAYER has been appointed district highway engineer by the Minnesota State Highway Commission, with office at Worthington, Minn. He is also in charge of the highway work in Nobles County, succeeding D. E. Davison, who goes to Rock County. During the past year Mr. Thayer has been assistant district engineer of Martin and Murray counties, and previous to that was employed by the Massachusetts State Highway Commission.

FRANK PAYNE, formerly with the Illinois Traction Company, later chief engineer of the Southern Illinois Railway & Power Company at Harrisburg, Ill., has been appointed general superintendent and chief engineer of the Southern Illinois & St. Louis Railway, with headquarters at Marion, Ill.

W. G. CAPLES, who has been appointed major of the First Battalion, Second Regiment of Engineers, in the field in Mexico, has been in charge of the Fourth Mississippi River District at New Orleans since 1914. Following his graduation from West Point in 1901 Major Caples' duties led him into the Philippines, where for two years he was engaged on road work and surveys for military posts and waterworks systems. After returning to the United States in 1903 some of his various duties to the date of his last appointment were road mapping, dredging operations, the design of snagboats and dredges and the development of processes of military lithography and sketching.

CARYL W. WILSON, of Sandpoint, Idaho, is now county engineer of Bonner County, succeeding Clyde J. Chaffins.

L. L. BAUMGARTNER was recently made city engineer of Decatur, Ind.

O. W. MOUNTFORT has resigned the position which he has held for six years in the construction and valuation departments of the Boston & Maine Railroad to enter the employ of the valuation department of the Pennsylvania Lines West of Pittsburgh as bridge pilot engineer. He is engaged at present in the field inventory of bridges in connection with the structural party of the Interstate Commerce Commission.

C. B. MAUTZ has resigned the position of assistant engineer, Chicago & Eastern Illinois Railroad, to join Mr. Putman under the firm name of Putman & Mautz, civil and mining engineers, Benton, Ill. At the time of leaving Mr. Mautz had been with the railroad for seven years, where his last position was engineer in charge of construction work at Danville, Ill.

S. D. BACON has been appointed division engineer, Texas & Pacific Railway, with offices at Marshall, Tex., to succeed H. P. Mobberly, resigned.

ARTHUR J. RHODES has been appointed city engineer from the position of assistant city engineer, Manhattan, Kan.

JOHN E. WILLIAMS, county surveyor of Pottawatomie County, Kansas, has been appointed county engineer of Shawnee County, with headquarters at Topeka, Kan., succeeding Walter Arnold.

D. GASTON WILKINSON has resigned as assistant county engineer, Clarke County, and taken charge of highway and bridge construction in Marengo County, Alabama. Mr. Wilkinson after being graduated from

Alabama Polytechnic Institute in 1905, spent several years on railroad location and construction in Alabama, and old Mexico. In 1909 he resigned the position of resident engineer, Mexico City Light & Power Company, to return to Alabama, where he engaged in general engineering practice until 1915, when he entered highway work.

BERT W. MACY, whose name appeared in this section in the issue of Jan. 20 as city engineer of Salem, Ore., is attorney for that city. Walter Skelton is city engineer.

SAMUEL J. HUMES, county engineer, King County, who took office Jan. 8, succeeding Arthur P. Denton, has appointed the following office aids: Chief deputy, Carl E. Morford; office assistant, C. P. Mowry; court engineer, R. B. Higbee; bridge engineer, Frank K. Adams.

FRED LANGFORD has been appointed city engineer, Sunnyside, Wash.

R. K. STOCKWELL, who has been chief engineer and superintendent of construction for the Braden Copper Company at Raucaque, Chile, for the past five years, will open a Western engineering and sales office of the Robins Conveying Belt Company in Salt Lake City. Mr. Stockwell while in Chile had charge of the civil and mechanical engineering work in connection with the construction of copper ore mills, electrolytic leaching, refining plants, mine structures and equipment, and other construction work at the copper mines. Before going to Chile he had eleven years of varied experience in the United States, chiefly in connection with steel mill machinery and smelting, refining and mining operations.

CATTELL, HOWARD & ASHTON, engineers, San Francisco, have announced that they have incorporated the firm and are prepared to undertake the following lines of work: Steam and electric railroads, bridges, buildings, foundations, harbors and terminals, water-supply and irrigation systems, industrial and manufacturing plants, sewers and sewage disposal, power developments and valuations.

GEORGE D. WHITTLE has accepted an appointment as highway bridge engineer in the Office of Public Roads and Rural Engineering, Washington, D. C. After he was graduated from the Massachusetts Institute of Technology in 1908 Mr. Whittle spent six years on railroad and municipal work in Texas and California, and during the last two and one-half years he has been in the bridge department of the California Highway Commission at Sacramento.

R. L. WHITCOMB, until recently assistant valuation engineer for the Philadelphia & Reading Railway, will enter the general contracting business, organizing the firm of Sobray-Whitcomb Company, 17 West Forty-second Street, New York City. Mr. Whitcomb was previously engaged in heavy

concrete and railroad construction. The new firm will make a specialty of reinforced-concrete design and construction and also will engage in railroad valuation.

J. E. HEISKANEN has left the Moulton Engineering Corporation, Portland, Me., where he was employed as designing engineer, to accept a position as chief draftsman with the American Writing Paper Company, Holyoke, Mass.

W. C. SWETT recently left the employ of the Kansas City Terminal Railway Company, where he was connected with the bridge department, to enter a similar department of the Chicago & North Western Railway.

WALTER KIDDE, engineer-constructor, 140 Cedar Street, New York City, has incorporated his organization under the name of Walter Kidde & Company, Inc. The combined construction and equipment of factories is to be one of the organization's specialties. Among its most recent commissions is the plant of the American Hard Rubber Company, at Akron, Ohio, which has buildings covering nearly 10 acres. The company is also prepared to handle projects such as harbor work and piers, chemical manufacturing plants, foundries, etc. The organization includes departments of construction, hydraulics, steam and mechanical engineering, electrical engineering and chemical engineering. Mr. Kidde, a graduate and trustee of Stevens Institute of Technology, will have with him his old associates as directors and stockholders of the new corporation. The officers of the company are: President, Walter Kidde; vice-president, B. G. Worth; secretary and treasurer, I. R. Lewis. Additional directors include Henry Lang, vice-president of the Ingersoll-Rand Company, and E. S. Boyer, who is associated with the American Hard Rubber Company. Other members of the organization include A. B. Miller, Walter S. Wainwright, M. I. Buttfeld and E. Schwarz.

REVOE C. BRIGGS has been transferred from aid in the U. S. Coast and Geodetic Survey to junior engineer in the Water Resources Branch of the U. S. Geological Survey. He is for the present assigned to the Oregon District, with headquarters at Portland.

J. B. MCCLAIN has been promoted from resident engineer to assistant bridge engineer with the Seaboard Air Line Railway. Mr. McClain has been with the Seaboard Air Line since 1906, when he started as bridge inspector and in 1911 was made resident engineer. During the past 10 years he has been in charge of the largest and heaviest bridge work put in by the road. This includes the Lincoln Street viaduct at Columbia, S. C., containing 131 spans and 242 separate pieces of masonry work; the Savannah River bridge, consisting of seventy-five 50-ft. girder spans, and the 2000-ft. reinforced-concrete Duval Street viaduct at Jacksonville, Fla.

BLISS & LAVALLE, architects and engineers, of Springfield, Mass., have associated with them F. R. Comstock, architect, formerly of Hartford, Conn., and New York City. Mr. Comstock has erected buildings in forty different states and in Canada.

GEORGE C. BUNKER, physiologist in charge of Canal Zone water purification, has returned to the Panama Canal after an investigation of the water supplies available for the U. S. Naval Station, Guantanamo Bay, Cuba.

A. V. DUNCANSON has recently accepted a position with the Minneapolis Park Board. After spending three years at the University of Minnesota he was engaged as cost engineer on the Minneapolis Filter Plant and with the Calgary (Alta.) Water Department. He has been engaged in valuation work with the Minneapolis Gas Light Company, with the Duluth Edison Electric Company and with the Twin City Rapid Transit Company.

NEWTON A. K. BUGBEE has been appointed state comptroller of New Jersey. The office is for a three-year term and carries with it a salary of \$6,000 per annum. Mr. Bugbee was formerly president of the Engineers' Club of Trenton and is secretary-treasurer of the Newton A. K. Bugbee Company, Inc., engineers and contractors, Trenton, N. J.

I. W. GEER, general superintendent of the Central System of the Pennsylvania Lines West of Pittsburgh, has been transferred to general superintendent of the southwest system, with headquarters at Columbus, Ohio. Mr. Geer was graduated from Yale University in 1895, and has been with the Pennsylvania Lines since that year, working up through the positions of assistant engineer, engineer maintenance of way and division superintendent.

S. B. ROBERTSON, until recently superintendent of the Cleveland & Pittsburgh division of the Pennsylvania Lines West of Pittsburgh, has been promoted to general superintendent of the central system of the Lines West. Mr. Robertson was born at Milton, Mass., on July 21, 1878, and was graduated from Massachusetts Institute of Technology, class of 1899. Following his graduation he had a year's experience on railroad bridge work as draftsman, and in 1900 entered the service of the Pennsylvania Lines West of Pittsburgh as assistant on engineer corps, Pittsburgh division. Later he was promoted to assistant engineer, and in December, 1904, was appointed division engineer of the Indianapolis division. He was advanced to superintendent of the Erie & Ashtabula division in 1911, and on July 1, 1915, was appointed superintendent of the Cleveland & Pittsburgh division.

R. H. SIMPSON, engineer with the Board of Public Works, Columbus, Ohio, has been appointed in charge of the subdivision of river channel improvement—a newly created division

under George A. Borden, service director. R. C. Chaney, assistant engineer in the grade-crossing department, and F. L. Simons in the street-construction department, have been assigned to Mr. Simpson as assistants.

J. A. NELSON has resigned from the position of vice-president of the East Jersey Pipe Corporation, and is at the present time taking a vacation and rest.

Obituary Notes

OLIVER HOWELL CRITTENDEN, chief engineer of the International & Great Northern Railroad, died Jan. 27 at his home in Houston, Tex.

LYMAN EDGAR COOLEY, one of Chicago's most noted consulting hydraulic engineers, died Feb. 3 at his home in Evanston, Ill. Known chiefly

Noted Consulting Hydraulic Engineer Who Died Feb. 3



LYMAN EDGAR COOLEY

for his connection with the Sanitary District of Chicago almost continuously since 1885, he was also identified with numerous other hydraulic projects in this country. He has appeared often before state and federal bodies, and as late as March, 1916, before the committee on flood control of the House of Representatives. Mr. Cooley was born in Canandaigua, N. Y., Dec. 5, 1850, and was graduated from the Rensselaer Polytechnic Institute in 1874. For three years he was professor in Northwestern University and for the next two years was associate editor of *Engineering News*. In 1878 he was assistant engineer on the construction of a railway bridge over the Missouri River at Glasgow, Mo. Then, until 1884, he was assistant U. S. engineer on the Mis-

sissippi and Missouri River improvements. The same year he took up, for a brief period, editorial work on the *American Engineer*. In 1885 he became projecting engineer for the Chicago Sanitary and Ship Canal, being in turn assistant and chief engineer, trustee and consulting engineer. Some of the other projects with which Mr. Cooley has been identified are as follows: Consulting engineer on the contractors' and engineers' trip to Panama and Nicaragua in 1897-98; advisory engineer, Erie Canal; consulting engineer, Denver Union Water Company on the Cheesman dam; member U. S. postal committee on pneumatic tubes for mail in cities; projecting engineer for water-power development at Keokuk; secretary and consulting engineer, Internal Improvement Commission of Illinois, 1906-09; consulting engineer, Lakes to Gulf Deep Waterway Association since 1909. His consulting work with the Sanitary District terminated barely a year ago, and although failing sight rendered reading difficult, he was active to the last, speaking only a few nights before his death at a meeting of the Western Society of Engineers. He was a past-president of this organization, and as one of the early members he had much to do with maintaining its autonomy. He was also a member of the American Society of Civil Engineers and the American Waterworks Association.

SAMUEL FORSYTHE THOMSON, civil engineer, died Jan. 30 at his home in Brooklyn, N. Y. Dating from the time of his graduation in 1896 from the Massachusetts Institute of Technology, Mr. Thomson's life has been spent largely in the service of the public in and around New York City. One of the two exceptions when he was not so engaged was during a period of 5 years when he was connected with the faculty of the U. S. Military Academy, West Point, N. Y. Following his graduation he joined the engineering staff of Col. George E. Waring, Jr., commissioner of street cleaning, New York City. After two years of general municipal work he went to West Point as assistant professor of civil and military engineering. Following this he was for a short period connected with the commission on additional water supply for New York City. In 1903 he entered the service of the New York Rapid Transit Commission, where, among other duties, he had charge of construction, under Robert Ridgway, of the East River tunnels. He was one of the first engineers to be connected with the Board of Water Supply, where he was acting division engineer of the Wallkill Division under Mr. Ridgway. Three years ago he returned to New York City with the Kingsbridge Construction Company, with which firm he was engineer on several contracts connected with the New York Subway. He was a member of the American Society of Civil Engineers, the New England Waterworks Association and of the Municipal Engineers of the City of New York.

Introduce 5-Ton Truck

The Federal Motor Truck Company of Detroit announces a new 5-ton model in addition to the firm's usual line of motor trucks. Before adding this new model to its line the Federal company drove the car thousands of miles up severe grades and over all sorts of roads that the tryout might be most thorough. One of the tests consisted of a trip of 1176 miles. The 5-ton truck was loaded with sand, driven from Detroit to Pittsburgh, and then back to Detroit over Pennsylvania, Ohio and Michigan roads. For three

screw, as it bites its way into the cork, secures a purchase and then backs the cork out. Ezy-Out backs the broken screw out on its own threads.

When a screw or stud snaps off, it is necessary only to drill a small hole in the broken screw and insert the extractor. It is given a slight twist to the left to seat it firmly in the hole. As it is twisted, its left-hand corkscrew-like spirals grip the sides of the drilled hole and exert a twisting, or rather untwisting, action on the broken screw.

The tighter the screw sticks the harder the tool grips, and when a



NEW MODEL 5-TON TRUCK MADE IN DETROIT

weeks the truck was driven up and down well-known Pittsburgh grades.

The mechanical features of the new model, which is a larger edition of the 3½-ton Federal, include the worm-drive rear axle, heavy motor with five-bearing crankshaft of nickel chrome steel and force-feed lubrication operated at a pressure of 150 lb. The cylinder block has separated heads to each cylinder to allow the combustion chambers to be machined inside, thereby insuring even compression.

An inclosed dry plate clutch connects the motor with a four-speed transmission mounted "amidship"; this, in turn, is connected with the rear axle worm shaft by a tubular propeller shaft with inclosed universal joints. Springs of strong chrome vanadium steel, radius rods, and hollow-spoke steel wheels are special features of the new model. The chassis was provided with a steel hydraulic dump body which, filled with sand, made a total load of 20,000 lb. The Federal engineers express gratification at the way the motor has handled this load on severe grades.

Screw Extractor Useful in Field and Shop

A new tool, called the Ezy-Out screw extractor, is manufactured in a range of sizes that make it useful in the field as well as in the shop. The principle of its operation is much the same as that employed by the ordinary cork-

wrench is brought into play, it is claimed that the screw will begin to "come" with very little trouble. The extractor is made of very tough steel, specially treated to withstand torsional strains. A folder describing Ezy-Out and its operation has been prepared by the manufacturer, the Cleveland Twist Drill Company.

New Stump Puller Will Reduce Cost of Clearing

A new stump pulling device, by which the cost of clearing land can be greatly reduced, has been invented by F. K. Kirsten, assistant professor in the electrical engineering department of the University of Washington. The puller is stationary, and it is said that ten acres can be cleared without moving the machine. The device consists of a bell-shaped drum, a long cable and a long steel arm. A stump is shaved down until it will allow the drum of the machine to fit over it. This is used as an anchor from which the cable is attached to the stump that is to be pulled. The steel arm is attached to the drum and horses are hitched to the arm. The cable tightens as the drum is turned by the horses and the stump is pulled. The pulling power of the horses can be multiplied any desired amount by increasing the length of the arm.

Professor Kirsten has used the new device on his Pierce County farm and finds that it works well.

Trade Publications

The following companies have recently issued trade literature:

Cement Tile Machinery Company, Waterloo, Iowa. "The Concrete Dope Book," second edition; dedicated to users and prospective users of Winner concrete mixers; 24 pages, illustrated, and full of information for concrete users.

Erie Machine Shops, Erie, Pa. Catalog and description of Erie tandem rollers.

American Cement Machine Company, Keokuk, Iowa. Catalog, 17; 30 pages, illustrated, describing mixers, powers, hoists and backfillers.

Barber Asphalt Paving Company, Philadelphia. "Barber Wood Block Book," 18 pages, illustrated.

Vanadium-Alloys Steel Company, Pittsburgh. Folder describing Vasco-Marvel, a semi-high-speed steel.

Sun Company, Philadelphia. Three 6 x 9-in. booklets devoted to Sun oils, ranging from 32 to 94 pages each. Vol. 1 is devoted to historical matters, Vol. 2 to production and Vol. 3 to pipe line and terminals. Much valuable information is contained in these booklets, more of which will be issued from time to time.

Barrett Company. Several booklets on Holt roof vent and leader connections, how to make form timbers rot-proof, and long life for wood at low cost.

Alpha Portland Cement Company, Easton, Pa. Catalog devoted to Alpha cement and telling how to use it. Ninety-six pages of illustrated information well worth having. Tables and drawings help to make the volume more interesting.

North Western Expanded Metal Company, Chicago. Booklets discussing wooden walls and ceilings for residence construction and expanded metal machine and belt guards.

Arc Welding Machine Company, New York City. Treatise on arc-welding operations and machinery, 34 pages, illustrated. Price \$1.

Western Electric Company. Electrical supply year book for 1917. More than 1300 pages, describing the firm's products. Indexed and illustrated.

Stephens-Adamson Manufacturing Company, Aurora, Ill. Title, "S-A" Labor-Saving Machinery. A reference book of information relating to the design and application of conveying, elevating, screening and transmission machinery and accessories. Cloth-bound, well illustrated and indexed. Besides the many blank note pages the volume contains 886 pages describing the company's products. Useful tables, diagrams and information are generously included in the contents of nearly every page.

Republic Creosoting Company, Indianapolis. Folder reprinting paper by P. C. Reilly on proper oil for treating creosoted wood paving blocks.

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The Cement Show

NO MATTER how well anything is done, it must be repeated often before it becomes a habit. This is true even of conventions and exhibitions. The Cement Show has been held so often and has been so well done that it can now be said to have become a habit, or rather that attendance thereat has become a habit. Engineers and contractors make an annual pilgrimage to Chicago in February to see what is new and to make up their minds what to use and buy during the next season. One can safely say that the show is now a permanent institution. It deserves the success it has won.

Planning for Clean-Up Week

CLEAN-UP WEEK has become a fixture in many cities. While the activity lasts but a week, the influence continues throughout the year. It is one of the many movements which, gaining headway during recent years, has helped to develop civic patriotism and a sense of responsibility to the community. For its immediate benefits as well as for its lasting influence, it behooves those in charge of the movement in each community to plan it carefully and to advertise it effectively. It is none too early to start now on plans. Already a considerable literature on this subject has been built up and is available through societies and publications devoting themselves to general civic movements. Reference to this literature will furnish an abundance of ideas, needing only individual initiative to give them life and force.

Standard Mixer Rating

WHILE the program which the National Association of Mixer Manufacturers has set for itself has been known for some time to those interested in the concrete field, it was not until the Cement Show last week that the association attempted to secure widespread publicity. Not only did it present its story well in advertisements in special numbers of journals distributed at the show, but gave further evidence of the new unity among mixer manufacturers by holding a joint exhibit. The work which has been planned cannot but be of value to the users of cement. Already the benefits of the standard method of rating are being appreciated. Now a 7-cu. ft. mixer (N. A. M. M. rating) is of a very definite size. What further advantages will come from co-ordinated efforts to improve mixing machinery, which is the next part of the program, can only be imagined; but judging by the caliber and progressiveness of the companies in the association one is

justified in expecting much. But if the work is in the right direction—and this journal believes that it is—engineers and contractors should show their faith and approval—yes, and their appreciation—by adopting the rating standards, based on mixed-batch measurements, that have been agreed upon.

The Universal Language

RECENTLY we have sat in at three meetings for the discussion of the management of foreign labor. At one of these Prof. Michael I. Pupin, himself an immigrant (many years back, it is true) gave as his formula for the solution of the problem, "So treat the immigrant that he will love you. Gain his confidence by fair treatment and interest in his progress and welfare." At another meeting W. O. Hay, vice-president of the Northampton Traction Company, Easton, Pa., an employer of many foreigners, pointed out the advantage of the foreman or manager who can speak the tongue of his immigrant employee. But in lieu of such knowledge he urged the frequent use of what he termed the universal language—the smile. We believe the two ideas are fundamental and so important that they are worth passing on to all employers, even to those who do not employ immigrants. In fact there is no one, even though he be a solitary worker, with no one under his direction, who cannot serve his own interests by living in the spirit of these two suggestions. Fair play, the confidence of associates, the disposition toward one's fellows and one's work that displays itself in a smile will help win in any walk of life.

Natural Cement

SOMEWHAT less than a year ago attention was scalped in these columns to the efforts being made in the Middle West to regain for natural cement some share of the big market lost when the price of Portland started on its sensational drop. Latterly, Portland prices have been pulling away from natural again, and the margin is so great that one cannot afford to neglect consideration of the older but less used product. Those who are trying to increase the market for natural cement report good progress during the year. They find prejudice, of course—prejudice born of a lack of knowledge among engineers and contractors of the qualities of natural. In fact, even the manufacturers of the particular brand being promoted strongly in the Middle West had forgotten an important quality of their product—that it is non-staining. This has at once opened a large market for the cement in question—Utica. Now we hear that the division engineers of the

Illinois Highway Commission, impelled by the great difference in price between Portland and natural, have recommended that the latter be tried this year for pavement base. Certainly a reliable natural will give a good account of itself for that use. If the price difference remains much longer, other highway departments and also engineering organizations charged with work where mass concrete is used will be going back to the older product. It has high merit, and though brands vary in composition and set, and some brands themselves lack uniformity from month to month, the strength is satisfactory for mass work and there is no shrinkage on setting. The intrinsic merits of the product combined with the price differential may result in again establishing natural cement as an important engineering material.

The Place of Publication Work in Society Activities

THE growth of the technical press, with its machinery for presenting quickly and concisely to the engineering profession and to the public at large the latest discoveries and the most recent achievements, has made unnecessary much of the work which was originally performed by engineering societies. Nevertheless, many of our newer associations persist in following along the old beaten track of publishing papers, not lifting their eyes from the ground and seeing the great neglected needs around them. Much of the money thus misused might better be expended in getting men together to discuss the present status and tendencies of affairs and to consider how best to help each other and the world in general."

These words, taken from an address delivered by Prof. F. H. Newell before the Cleveland Engineering Society, Nov. 21, 1916, express a thought that has been emphasized previously in these columns. The publishing and discussion of technical papers is generally one of the specified objects of engineering societies. Being a definite and specified object, its propriety as a function of the society and its place in the budget has seldom been questioned. This has been unfortunate, for, as this journal has shown, many papers have been printed that were a waste of funds. One has but to examine the financial statements of some of our national organizations and note that \$50,000 and upwards is spent by individual organizations each year in printing to realize that no organization of scientific men should permit the practice to go on without a very careful scrutiny of the efficiency of the expenditure.

Personally, we agree with Professor Newell that in many cases funds had better be diverted to other ends. Were standards as strict as those of first-class technical journals adopted by the national societies the volume of their publications would shrink greatly. In saying this, we fully recognize that there must be some agency through which original research can be given to the profession, but original research has formed

less than half of the data published by our national societies and cannot be advanced as a defense by the proponents of the extensive publishing interests of these organizations.

Road Work with Convicts

EVEN allowing full value to the fact that selected men were used in the model convict road camp maintained under the director of the Office of Public Roads by Fulton County, Georgia, and described on page 250, the results obtained warrant an extension of this work to other locations and an application of the experience so gained to a wider area and to larger units. Certainly, the year's experiment has justified its cost, and if many counties, or even perhaps a state, do not carry on the work, it will be only because of a lack of appreciation for economy and humanitarian penology.

The economy has been proved beyond the possibility of doubt. More actual work was accomplished than under the system of gun-armed guards, chain gangs, and flogging. The unit costs were lower than for similar work handled with free labor. Sickness and disease were avoided to a truly remarkable degree, and by applying only the simplest sanitary precautions. There were no attempts at escape, even though certain sections of the work were as much as 4 miles from the camp and in spite of the fact that the only locked door in camp was to prevent peculation from the commissary.

When it is kept in mind that this experiment was not run for any "sob-sister" reasons but merely to attain a set of data of practical applicability, the results are gratifying. Inasmuch as it meant a journey into strange fields, the first year's work has answered so many moot questions that there should be no shadow of uncertainty as to the soundness of reasoning and carefulness of preparation.

It is refreshing to realize, too, that there are men of talent who are devoting much or all of their time to the care of that percentage of derelicts which every community produces, and to the utilization of their time in such a way as to make to the community some recompense for the harm they have done.

Local Pride and Inefficiency

ANEW City Hall is to be built shortly in Macon, Ga., and the council has taken action barring all but Macon firms from bidding. This action can mean only one thing—that outside contractors would do the work for less than the local firms care to bid. Either the local firms are inefficient or they are bent on extracting a profit of undue proportions from the city. We take it for granted that the administration is honest and therefore do not suggest that any ulterior personal motives may have prompted the action.

In the case of road construction, a community may be justified in expending money to teach local contractors the business, as the entire territory will profit

eventually from this policy. However, building work, unlike road construction, is in an advance stage of specialization. This excuse, therefore, cannot be offered by the Macon Council. If the builders of the city are not already up to standard in their calling, such action as this will never put them there.

Perhaps the theory of "keeping the money at home" is being given undue emphasis. Every community should take a pride in its own upbuilding, but to attempt to do it by nursing inefficiency is merely to encourage lower standards that must eventually be hurtful to the life of the community. Moreover, the slogan, "Keep the money at home!" is frequently used to throw dust into the eyes of the unthinking. The wages of the labor, the cost of the material furnished locally and the bulk of the overhead expense on a construction project are, of course, turned right back into local circulation. Only a relatively small per cent of the cost of improvements is taken away by an outside contractor. And if he can bid so much below local firms that the latter have to be protected in their own backyards by city ordinance, then the outsider can evidently save the taxpayer a sum which will make it to the advantage of the city to let him carry off a little profit.

Is Macon still living in the last generation?

To Improve Structural Organizations

WHILE recognizing that any form of organization is dependent quite as much upon the personnel of the workers as upon details of function and operation, particularly in the case of engineering work where technical ability is of primary importance, fundamental principles which should be applied in the field of structural design and detailing are too generally violated. Before considering some of these principles, it should again be emphasized that in the actual selection of men to fill vacancies occurring in all engineering organizations, the essential requirements should be technical skill and experience. While personal characteristics, such as initiative, enthusiasm, good habits and clear thinking, are also requisite, the proper balance between these and thorough technical training should always be insisted upon—in fact, continuous devotion to technical work in itself results in initiative, enthusiasm and other requirements which writers on efficiency too often consider as qualities to be developed in some special manner by extraneous means.

Granting that the body of workers in a drafting room or a designing office are technically equipped, each for his particular job, there is undoubtedly a wide variation in the amount and quality of the work done under different systems of organization or management. It is a serious question whether the general practice now followed in American fabricating companies or in large consulting engineers' offices even approaches that degree of efficiency which is being attained in other organizations. Some of those principles of management which apply particularly in this field should therefore receive serious consideration.

In the first place, there should be centralized control by a single head—the chief engineer, chief designer or chief draftsman, a man entirely competent to decide general questions and also matters of important detail. Extensive work should be assigned to squads carefully selected for congeniality and complementary abilities and guided by a working leader or "squad boss" capable of stimulating his men to their best efforts without driving them. Proper checking should be insisted upon, either by the separate check of another member of the squad familiar with the work in the case of detailing, or by the designer himself in the case of design work. There should be, also, recorded decisions on all important questions and a general checking during the progress of the design by the chief designer. To prevent mental fatigue, there should be rest periods, fresh air, stimulating exercise, quiet working conditions—all of which are of the utmost importance in brain work of this kind. Finally, the men should be stimulated by bonus payments for all work rapidly done.

The particular details of the application of these principles to any organization can best be worked out for each case according to the special requirements of the organization. Several pitfalls should, however, be carefully avoided. While simple and easily made records of all work, or a log of the operations and decisions or orders on each job, should be kept in permanent form, the use of too much red tape, multitudinous red, blue or green index or filing cards and the multiplication of clerical operations will often counteract the usefulness of any system. Unnecessary expenditures in this direction should be eliminated; in fact, one of the most effective means of creating profits for any large organization lies in the employment of a "watch dog" for expenditures, who will know enough of all the details of the work being done to stop the leaks and excess costs which are almost sure to occur without supervision. By thus reducing wasteful expense it is often possible to create the funds for bonus payments and thus answer the argument sometimes raised against the bonus system.

A really worth-while system rewarding suggestions for improvements in work or methods and encouraging the workers themselves to make such suggestions will often transform the spirit of an organization, provided these suggestions are properly handled, and the reasons for adoption or rejection carefully stated. In a word, complete co-operation between those who give orders and those who actually do the work is the well-recognized basis for all successful organization. A workable system of profit sharing, immediate in application and fair in distribution, should form a part of the plan—and by no means the least important part in these days when salaried men must perform some difficult mathematical computations to extend income to meet expense. Now that preparedness for exceptional competition after the war is so much discussed, the management of engineering organizations must apply fundamental principles of efficiency or run the risk of losing out in the more strenuous times which are predicted.

EXPERIMENTAL CONVICT ROAD CAMP



Model Camp of Office of Public Roads in Fulton County, Georgia, Is Described, and Some of the Reasons for Its Successful Operation Are Detailed

By GEORGE D. STEELE

Consulting Highway Engineer, Philadelphia

WITH the rapid strides that have been made in highway construction throughout the United States during the past several years, there has been a correspondingly increased interest taken in the subject of the utilization of prison or convict labor. There have been several reasons for this—some selfish and others purely for the moral and physical uplift of the unfortunates who have been so employed.

It is only a few years ago that the use of convict labor was almost exclusively confined to a few of the Southern states, where, it is safe to say, except possibly in a few rare instances, the use of this labor was planned with the intention of securing highway improvements at little or no more cost than was necessary for the housing and feeding of the prisoners in the prisons. In these early cases the gang system was generally used, the men working in stripes, usually in chains and under guards who were heavily armed. But state after state has taken up the utilization of convict labor in recent years, until it is now common in all sections of the country. With the growth of the use of this class of labor, conditions from the prisoners' standpoints have improved materially, though there is still room for much more improvement.

OFFICE OF PUBLIC ROADS INVESTIGATES

With the marked increase in the utilization of convict labor and the establishment of many additional camps, the Office of Public Roads and Rural Engineering became interested and a small appropriation for investigating the utilization of convict labor in road management was made in 1914. Representatives of the Office of Public Roads and Rural Engineering, together with representatives of the U. S. Public Health Service, visited convict camps in all parts of the United States, studied the construction of the camps, the feeding and clothing of the men, the systems of guarding them and the work accomplished. These visits were supplemented

by data secured from the governors of states, from state highway commissioners and from the prison authorities. An idea of the scope of these studies may be had when it is mentioned that they were made in New York State, New Jersey, Michigan, Colorado, Wyoming, Utah, Oregon, Washington, Arizona, New Mexico, Texas, Alabama, Georgia, Florida, North Carolina, South Carolina and Virginia.

SCOPE OF WORK IS COMPREHENSIVE

The studies referred to covered "the management, operation, discipline and results obtained in convict road camps throughout the United States, in order that a report might be issued which will be helpful to the states and counties in the management of convict road camps, in determining the character of structures necessary and the proper method of erecting the same, in the selection and use of equipment, and in the handling of the various questions of sanitation, diet and clothing, so as to secure the best results commensurate with the welfare of the convicts." This covered the inspection of camps and the collection of data, and was practically completed during 1915. The scope of the work was enlarged during the fiscal year 1915-1916, when an appropriation was asked for "to study the management, operation, discipline and results obtained in convict road camps, and to test, under co-operative arrangements with state and local authorities, systems of record and cost keeping, and management devised by the Office of Public Roads and Rural Engineering."

The result of this work was so interesting and of such value that it was decided to extend it in such a manner that direction and supervision, in the main, should be under the Office of Public Roads. An appropriation was made in 1915 "to ascertain by observation of a camp constructed and operated as an experimental camp, the most practical structures, equipment, sanitation, clothing, diet, organization, discipline and methods

of management to be used in connection with the use of convicts for road construction," and it was decided to select a camp in a county which would conform to the plans and suggestions formulated by the Office of Public Roads and the U. S. Public Health Service. The representatives of the office were to make careful observation of the results obtained in the management of the camp, the cost of operation, the effects upon the prisoners and the economic results to the county.

GEORGIA CONDITIONS CONSIDERED BEST

Late in December, 1915, Seaborn, Fulton County, Georgia, was selected for the establishment of this experimental camp, and the recommendations of the Office of Public Roads and Rural Engineering with reference to structures, management, records, etc., were followed, and the recommendations of the Public Health Service adopted as to sanitation, diet and health conditions. The county board of commissioners agreed to bear the entire expense of the camp, except the salaries of three of the officials and employees, who were to obtain the particular data desired from the investigation and to see that the recommendations of the office were strictly carried out. The government had, therefore, control over the location and erection of all buildings, the source and distribution of the water supply, all surveys for road work to be attempted, the entire system of cost accounting, the selection and distribution of rations, the disciplining of the men inhabiting the camp, the furniture and equipment, and other minor details.

The average population of the camp since it was established, Jan. 10, 1916, has been forty men convicts per day. With but three or four exceptions, these have been negro misdemeanor prisoners whose sentences average between seven and eight months, and who were secured from the Fulton County prison.

NO CHAINS OR FIREARMS USED

The officials of the camp consist of a deputy warden, two foremen, one camp clerk and one night watchman, whose only duties, so far, have been to protect the commissary. The men are all employed under the honor system, no armed guards being permitted at this camp.

All the prisoners are clothed in neat brown suits marked with the prisoner's number. There have been



THE COMMISSARY IS THE ONLY BUILDING WITH LOCKS AND BARS

no escapes or attempts at escape up to the first of this year, although about one hundred different men have been quartered at the camp in the year of its operation. Only three of these have been sent back to the prison or to the chain camps, the only methods of disciplining that are used; two of these being returned for fighting and the third for the general dissatisfaction which he gave and caused. The authorities at the experimental camp are not allowed to flog the men, and it is worthy of mention that this is the only convict camp in Georgia where whipping of the prisoners for infractions of the rules is not permitted. The men are treated as human beings and are allowed practically all the privileges of a free labor camp. There are no barred windows, chains or locked doors, except on the commissary building.

MEN GRANTED UNUSUAL LIBERTIES

The privileges that are granted to the men are unusually liberal. The time from their return from work late in the afternoon until they go to bed at night is theirs to do with as they please, either inside or outside the buildings. Saturday is a half-holiday throughout the summer, and is usually a gala day on which there are baseball games and other sports. A phonograph with a supply of records is placed in the building used as the sleeping quarters, writing tables are conveniently located and books and magazines are there for all who care to make use of them. The men are permitted to write and receive as many letters as they wish, although all correspondence is read by the authorities before it is mailed out or delivered to the prisoners.

The food is more varied and of a better class than is furnished to prisoners of any other camp in the state. This has been voluntarily attested to in every case where a prisoner was brought to the experimental camp after he had been in one of the others. One of the prisoners serves as cook, and his sole duty is the preparation of the meals. The steward, who is also the camp clerk, is not a prisoner.

The quantities of food for each man have been scientifically worked out and are closely adhered to. The menu is varied, however, as may be noted from the accompanying table, which shows the average



THE KITCHEN END OF THE MESS QUARTERS SHOWS THE PORTABLE CONSTRUCTION

number of ounces of the various foods which constitute the daily rations per man.

DAILY RATIONS PER MAN, IN OUNCES			
Beef	14	Turnips	12
Corned beef	12	Cabbage	12
Salt pork	8	Onions	12
Fresh fish	12	Carrots	12
Salt cod	5	Greens	12
Salt herring	5	Eggs	2
Salt mackerel	5	Oatmeal	2
Flour	8	Prunes	2
Meal	8	Condensed milk	1 to 2
Macaroni	2 4 to 3.0	Sugar	1 1/2
Beans	4	Cheese	1 to 3
Peas	4	Coffee	0.4
Rice	2	Molasses	2 to 4
Potatoes	16 to 24	Dried fruit	1.3
Sweet potatoes	16	Oleomargarine	0.5

During the first six months of 1916 the beef furnished averaged 8½ cents per pound; corned beef, 12 cents; salt pork, 10 cents, and fresh fish, 5 cents. The following figures, taken at random from the camp records, are for the month of March, 1916, this month being about the middle of the period between the opening of the camp and the close of the government fiscal year. For this reason they may be considered as average:

Daily number of officers.....	7.97
Daily number of convicts.....	39.33
<i>Daily Cost of Food</i>	
For officers	\$0.235
For convicts	.1714
The total cost for March, 1916, was:	
Food for officers	\$63.09
Food for convicts	209.30
Total cost of food.....	\$272.39

All purchasing for the camp is systematized and must go through regular channels, so that a constant check is kept on everything that goes into the camp and for what it is intended and used. When an article is required it is sent through on a regular county requisition by the camp clerk to the county purchasing agent at Atlanta, purchased by the latter official and forwarded to the camp. The invoice is in duplicate, and the camp clerk checks the bill, returning it to the county accounting department. It is then presented to the Board of Commissioners, which issues a warrant on the county treasurer.

HEALTH CONDITIONS ARE UNUSUALLY GOOD

Health conditions at the camp for the first year of its operation have been far better than had been anticipated. There have been no deaths and no serious accidents. Only three-tenths of one per cent of the inhabitants of the camp have had to have medical attention, which is a remarkably low record, perhaps traceable to the excellent sanitary conditions. The prison physician from Atlanta visits the camp once a week, and at any other time upon call of the camp authorities. When a case has had attention, and continues to need medical care after the doctor has made his first call, the patient is sent at once to the Barracks Hospital at the county prison, remaining there until he is entirely well.

The rules of the camp require the men to bathe at least once a week in the winter, and at least twice a week in the summer, though they are allowed to bathe as much oftener as they desire. Quite a number took daily baths last summer. About 15 gal. of water per

man is required for bathing, and an additional 15 gal. per man is used for washing and the preparation of food. All clothes are washed once a week at the Bellewood Barracks, where clothes from all the camps are thoroughly cleansed. A laundry truck makes the round of the camps, collecting the clothes and delivering them to the laundry, and then redistributing them to the camps. Since every piece of clothing bears the registered prison number of the owner, there is little or no confusion.

ALL BUILDINGS OF SPECIAL DESIGN

There are four buildings—namely, the office, commissary, sleeping quarters and mess hall—costing approximately \$1,600. Their life is estimated at seven years, and all repairs are charged to the quarters account. The sleeping quarters and the mess hall and kitchen



THE GARBAGE INCINERATOR, CONSTRUCTED BY MEMBERS OF THE CAMP, IS MADE FROM STONE AND MUD

are supplied with running water, as is also the large bath tent, which stands at the rear of the sleeping quarters. Water is secured from a well that was drilled while the camp was being constructed. In this well is an automatic compressed air pump driven by a gasoline engine.

The sleeping quarters are plain, with a minimum of furniture. There is one chair beside each bed, which is a double-deck metal cot provided with a straw mattress. The sleeping quarters are well ventilated and aired weekly, and all bedding is kept clean and sanitary.

The buildings composing the camp are heated with adequate stoves in which wood is generally burned. High windows afford ample ventilation without drafts, and there is an abundance of light. A stove has also been provided in the bath tent so that there can be no excuse for not taking baths in cold weather.

A small home-made garbage incinerator, constructed of stone and mud, takes care of the dry and semi-dry wastes from all parts of the camp. The slop from the camp is traded to the farmers in the vicinity for milk and eggs, and enough of the latter are secured in this way to provide amply the requirements of the officers' mess. This slop was formerly fed to several pigs that were kept at the camp, but they were disposed of, as it was found that they attracted and bred flies.

Twelve teams of mules are generally kept at the camp—in an open shed in wet weather and in an open corral back of this shed in good weather. They are fed in the open shed or stable and watered at a stream that runs through the end of the corral. It has been found considerably cheaper to own and keep the mules than to hire them, the cost per team per day being about \$1.60, which includes blacksmithing, medicine, feed and the work around the corral.

WORK DONE WAS MAINLY HEAVY GRADING

In the first nine months of the operation of this experimental camp, grading was completed on about 2 miles of road. This was heavy work, as more than 25,000 cu. yd. of material were excavated, of which about 25 per cent was rock. These 2 miles of road are now being top-soiled and guttered with cobbles, the latter being necessary on account of the heavy grades and danger of washouts. One mile of a side road was also graded with a road machine and 8000 cu. yd. of grading was done on another road. In addition to this work, there has also been a large amount of minor work completed, including that around the camp. The men are working at a much higher efficiency than are the men at any of the other county camps, and seem to take an interest in their work. They are frequently sent in considerable numbers as far as 4 miles away from the camp, and in every case so far have shown their appreciation of the confidence that is placed in them.

Complete cost records on the operation of the camp will soon be available, and there is no doubt that they will be of more than ordinary interest when they are given to the public and others interested, as they will be in the form of a bulletin to be issued by the Office of Public Roads and Rural Engineering.

W. Tom Winn is chairman of the County Commissioners of Fulton County and co-operated with R. F. Eastham, who was assigned by the Office of Public Roads and Rural Engineering to act as resident engineer.

Poughkeepsie Bridge Again Being Reinforced—New Floor System

Changing Present Double Track to Single Track for Cooper's E-60 Loading at Estimated Total Cost of \$330,000

WORK is now under way on the reinforcing of the Poughkeepsie Bridge of the Central New England Railway over the Hudson River at Poughkeepsie, N. Y. This bridge is an important link in the New Haven system, forming one of the main gateways connecting New England with the West. The total cost of reinforcing the structure is estimated at \$330,000.

The Poughkeepsie Bridge, 6767 ft. long, with 163 ft. clearance above high water, was built in 1889 and 1890, designed for a loading of two locomotives with 24,000 lb. on each main axle followed by 3000 lb. per linear foot. In 1906 and 1907 it was reinforced to carry 45,000 lb. axle loads followed by 3600 lb. per linear foot. This work was described in the Engineering Record of Aug. 18, 1906, page 178 (showing a general elevation, span lengths and how approach girders were replaced); of Nov. 9, 1907, page 502 (reconstruction

of anchor piers—new eyebars and reaction girders), and in 1909, Sept. 25, page 349; Oct. 9, page 405, and Oct. 30, page 502 (changing pier 1, replacing approach spans, and details of high falsework).

CHANGING TO SINGLE TRACK

The reinforcing of the present double-track structure, with capacity corresponding approximately to Cooper's E-35 loading on each track, will consist in changing the floor system of the main bridge spans to distribute the load equally among the three trusses from a single track placed in the center. The bridge will then be operated as single track on the main structure and double track on the approaches. The approaches will be strengthened for the heavy loading by the addition of metal in the tower bents and in the approach deck spans. The reinforced main structure, operated as single track, will be capable of carrying a loading corresponding to Cooper's E-60, with two heavy engines of the Santa Fe type 2-10-2.

The work of reinforcing the bridge is planned so that there will be no interruption to traffic. It is expected that the work will be completed and the bridge ready for operation under the new loading during September, 1917. Approximately 1800 tons of new steel will be required for reinforcing the main structure, and 340 tons for the east approach and 70 tons for the west approach. The contract for the work has been let to the Strobel Steel Construction Company. The engineers in charge are Modjeski & Angier. The steel work is being manufactured by the Fort Pitt Bridge Works, Pittsburgh.

Data on Absorption Losses from Reservoirs Collected by Canadian Department

Data showing the evaporation from a free water surface have been collected at Strathmore and Lethbridge, Alta., Canada. Galvanized-iron tanks 4 ft. in diameter and 18 in. deep were set in the ground with the top from 1 to 2 ft. above the ground. Careful account was kept of the amount of water added or taken out to keep the surface at a fixed point within the tanks at approximately the same elevation as the surrounding ground. The data, published in the annual report of the Department of the Interior of Canada for the year ended March 31, 1916, are given in the following tables:

EVAPORATION FROM FREE WATER SURFACE—STRATHMORE, ALTA., 1915

Month	Total evaporation in inches	Mean daily evaporation in inches
April	4.22	.141
May	1.73	.153
June	1.33	.143
July	6.47	.209
August	4.25	.137
September	3.27	.076
October	1.78	.059
Total	28.05	

EVAPORATION FROM FREE WATER SURFACE—COALDALE, ALTA., 1915

Month	Total evaporation in inches	Mean daily evaporation in inches
April	5.68	.189
May	4.28	.138
June	2.26	.075
July	4.38	.141
August	4.97	.160
September	2.93	.098
Total	24.50	

Simple and Cantilever K-Trusses Analyzed

Part II—Formulas Derived and Influence Lines Drawn for Chord and Web Stresses and Applied to the Determination of Maximum Stresses

By C. L. WARWICK

Instructor in Civil Engineering, University of Pennsylvania, Philadelphia

[IN PART I, which appeared in last week's issue, page 223, Mr. Warwick presented the complete analysis for single-span conditions, and compared the K-truss secondary system with that used in the Pettit truss. In Part II the analysis is made for a cantilever arm, and methods for the determination of maximum stress in a typical web member are described both for simple span and for cantilever arm.—EDITOR.]

Fig. 4 shows the truss acting as a cantilever arm; the free end is at a, and the effect of the anchorage may be represented for the purpose of this discussion by horizontal reactions at N and n. The application of the foregoing analysis to the determination of chord and web stresses in a cantilever arm will now be made.

Chord Stresses—Taking section 1-1, Fig. 4, it is evident that stresses EG and eg are zero for loads at and to the right of e'. With a unit load in any position from c' to the left, at a distance x from the free end, stress d'e' is zero, and taking moments about e or E, there is obtained,

$$\text{horizontal component EG} = \text{horizontal component eg} \\ = \frac{r-x}{h} \quad (13)$$

Stress EG is tensile and stress eg compressive, and each becomes maximum when the load is at a.

With the load at d', it has been seen that the algebraic sum of the moments about e of stress d'e' and the load is zero. Therefore stress EG is zero, which is also evident from other considerations. Then, from $\Sigma H = 0$ at section 1-1, the horizontal components of stresses eg and d'e' are equal, or

$$\text{horizontal component eg} = \frac{p_1}{h_1} \quad (14)$$

The influence lines aa'cdn and aa'cden, Fig. 4 (a) and (b), may now be constructed, and require no further explanation. If the members c'E and d'e' are parallel, line cd in Fig. 4 (b) will be horizontal.

Web Stresses—Considering e'G, take section 2-2, Fig. 4. O_1 is the moment center. Loads in any position from f' to the right do not stress e'G. Placing a unit load in any position from c' to the left, stress d'e' is zero, and the tensile stress in e'G is

$$e'G = \frac{x+v}{z} \quad (15)$$

Equation 15 applies for the unit load at e' by substituting r for x. For the unit load at d', the analysis leading to equation 7 may be applied; or, more simply, moments may be taken about g, the intersection of e'f' and eg, since for this condition of loading stress EG is zero. The lever arm of e'G about g being Ph'/i ($=Pz/t$), the following equation for tensile stress is obtained:

$$e'G = \frac{P-p_1}{P} \times \frac{t}{z} \quad (16)$$

The influence line for stress e'G is aa'cdefn, Fig. 4

(c); d is located by prolonging ge to the vertical through d', for since the ordinate e'e = t/z, d'd must equal equation 16.

The analysis for stress e'f' is similar to that for stress e'G, and leads to the influence aa'cdefn, Fig. 4 (d). The influence line for stress f'g is aa'cdefgn, Fig. 4 (d), the ordinate ff₁ being equal to stress f'g from a unit load at f' ($=i_1/h_1'$). The method of constructing Fig. 4 (d) is similar to that used for Fig. 2 (d). If the members e'G and f'g' are parallel, line ef₁ will be horizontal.

The stresses in the verticals follow directly from those in the diagonals, as previously explained.

A complete analysis should include the effect of loads on the suspended span. This may readily be done by constructing the influence lines for such loads, which will consist of straight lines, shown in part by the lines s'a', Fig. 4, extending from the points a' to the intersection of the base lines na, prolonged, with a vertical through the far end of the suspended span.

DETERMINATION OF MAXIMUM STRESSES

The methods of stress analysis which have been described, although developed for a moving concentrated load of unit intensity, may obviously be applied to the determination of dead and live-load stresses by algebraic methods. For complicated truss systems, the dead-load stresses are often determined graphically by constructing a stress diagram. In the case of live-load stresses, however, which in general become maximum for different members under different conditions of loading, the use of stress diagrams is not so convenient; and the stresses are in general preferably determined either algebraically or from influence lines, or by a combination of these two methods.

Simple Span—As an illustration, let it be required to determine the maximum tension in e'G due to a concentrated load system, considering the truss to act as a simple span. Referring to the influence line, Fig. 2 (c), it is seen that the loads must extend over the portions a of the span, as shown in Fig. 5, with the heavier ones near d' and e'. The exact position of the load system for maximum stress may be found as follows:

Referring to Fig. 5, stress e'G = M/z , in which M is the moment about O_1 of stresses e'f', EG and eg at section 2-2 and the external forces to the right, namely, the reaction R_n and the floorbeam concentration at f' ($=r_f$). The moment of stress e'f' about O_1 is zero. Referring to the analysis leading to equation 7, the moment about O_1 of the resultant of stresses EG and eg is equal to its horizontal component, which has the value $r_d p_1/h_1$, multiplied by OO_1 . Therefore

$$M = R_n(l+v) - r_f u + r_d \frac{p_1}{h_1} \times \frac{t+P}{P} h_1 \quad (17)$$

in which R_n , r_f and r_d have the values given in Fig. 5. To determine the condition or criterion for which M,

and therefore stress $e'G$, will be maximum, equate dM/dx to zero:

$$\frac{dM}{dx} = \frac{W(l-v)}{l} - \frac{Wu}{p_2} + \frac{p_1}{p_2} \times \frac{t+P}{P} \left(W_1 - \frac{P_1}{p_1} W_2 \right) = 0$$

Solving,

$$\frac{l+v}{l} W - \frac{u}{p_2} W - \frac{p_1}{p_2} \times \frac{t+P}{P} \left(W_1 - \frac{P_1}{p_1} W_2 \right) = 0 \quad (18)$$

For maximum stress, therefore, the load system must occupy such a position that equation 18 is satisfied, which can occur only as some wheel (the critical wheel)

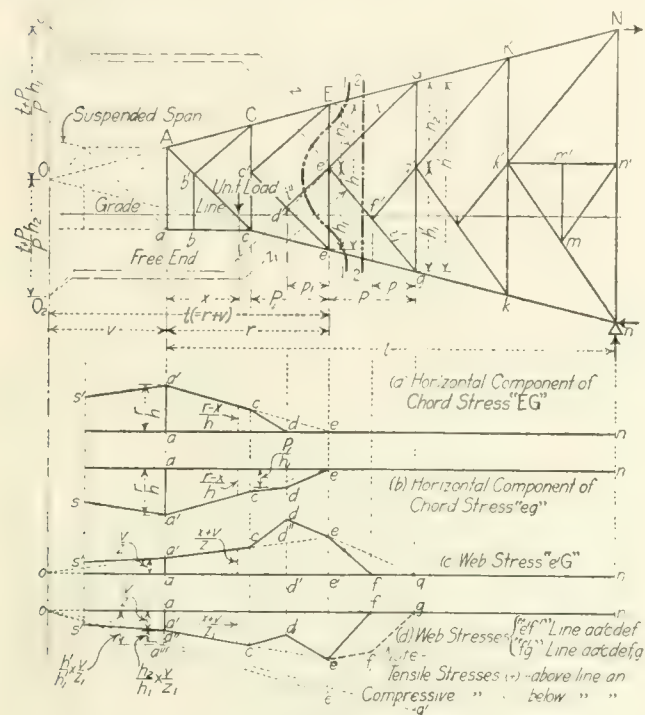


FIG. 4

Influence Lines for Stresses—Truss Acting as Cantilever Arm

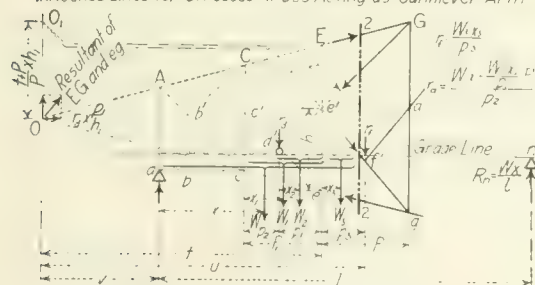


FIG. 5

Position of Concentrated Load System for Maximum Tension in eG (Simple Span)

passes d' or e' . In Fig. 5, the critical wheel is shown at d' , which is the more favorable position for satisfying the criterion, since the influence line at that point, Fig. 2 (c), is more sharply concave downward than at e' . With the load system in position, M may be computed from equation 17; whence stress $e'G = M/z$.

Or, the stress may be found by summing the products of each load by the length of the ordinate to the influence line beneath the load, such a summation being facilitated by using a rider on the scale to add the ordinates under loads of equal intensity. This method is especially convenient when the algebraic expression for stress and the criterion for maximum are complicated, as, for example, in determining the maximum compressive stress in $f'g$, for which the influence line, Fig.

2 (d), is relatively complicated. In that event, the position of load may be approximated with sufficient accuracy by trial.

If an equivalent uniform load is used in place of the concentrated load system, as is frequently done in long-span bridges, the conditions are simplified exactly as in the case of the usual truss analysis.

Anchor Arm—The analysis for maximum stresses in a simple span applies to an anchor arm under its own loading. Loads on the cantilever arm and suspended span cause an uplift at the anchorage, and the negative reaction developed there may be treated as a load at the end of the anchor arm acting as a cantilever arm. The stresses in the anchor arm from this condition of loading may most readily be determined by constructing a stress diagram.

Cantilever Arm—The analysis for maximum stresses in a cantilever arm is slightly different from that for a simple span. Calling the length of the suspended span l_s , the total load in that length W_s , and the distance of the center of gravity of W_s from the far support x_s , the proportion of W_s transmitted to a , Fig. 4, is $W_s x_s / l_s$. Then for maximum stress in $e'G$, for example, the following equation of moments about O_1 of stresses and external forces to the left of section 2-2 may be written, using the notation of Fig. 5:

$$M = e'G \times z = \frac{W_s x_s}{l_s} v - W(x + v) - r_f u - r_d \frac{p_1}{h_1} \times \frac{t+P}{P} h_1 \quad (19)$$

Substituting the values of r_f and r_d , and equating dM/dx to zero, the criterion for maximum stress is

$$\frac{v}{l_s} W_s + W - \frac{u}{p_2} W - \frac{p_1}{p_2} \times \frac{t+P}{P} \left(W_1 - \frac{P_1}{p_1} W_2 \right) = 0 \quad (20)$$

With the loading in position for maximum, the stress may be found by either of the methods outlined for simple spans.

35-Mile Road in Oklahoma Being Built by Convict Labor—Men Are Not Paid

Pollatallomie County, Oklahoma, the state and the U. S. Office of Public Roads and Rural Engineering are co-operating in building a 35-mile road which passes through the important towns of that county. Necessary funds and a portion of the equipment are furnished by the county, the state providing the remainder of the equipment, 50 negro prisoners and four employees. The work is under the supervision of a U. S. road engineer. The National Committee on Prisons is watching the experiment with interest as a step toward affording opportunity for work to many Oklahoma convicts. The framers of the Oklahoma constitution took an advanced attitude when they inserted a provision in the constitution prohibiting the contracting of convict labor. The state has, therefore, no contract system to abolish and is in a position to forge ahead in building up its prison industries. The work is undertaken as a demonstration of what can be done with state convict labor. As no wages are paid to the convicts, cost figures are not easily available. Other states have found it practicable to pay the prisoners for their work with resulting greater efficiency.

Experiences with Standard Types of Roads Furnish Basis for Discussion

Abstracts of Papers Delivered at Fourteenth Annual Convention
of American Road Builders' Association at Boston, February 5 to 9

Massachusetts Commission Relies on Asphalt, Oil and Tar

By W. R. FARRINGTON

Division Engineer, Massachusetts Highway Commission

VARIOUS bituminous materials are being used extensively on the heavier traveled roads outside the cities. The usual form of construction is a base of broken stone 3 to 5 in. thick, with a top or wearing course 2 to 3 in. thick, consisting of broken stone mixed with the bituminous material. Formerly it was customary only to use stone up to $1\frac{1}{4}$ or $1\frac{1}{2}$ -in. size in the wearing course, but at present the small stone is put in the lower course to get rid of it.

Sand and oil roads were first constructed in Massachusetts in 1905. As constructed with the sand usually available and without the addition of other aggregate they will not carry much heavy travel, especially if the proportion of horse-drawn vehicles is large. Experiments are being made with cement and stone dust additions, and the results indicate that some combination may be found which will result in a surface that will carry heavy travel economically.

SAND-OIL HEATING EQUIPMENT IS SIMPLE

The usual outfit for sand-oil surfacing consists of a mixer similar to a concrete mixer with charging device, and in most cases is equipped with a heating attachment and a mechanical drier. These driers are similar to the conventional drying drums, but the flame is thrown either directly into the end of the drum or into a combustion chamber at one end. The asphalt or oil asphalt is heated in kettles before mixing, and where the ordinary hot attachment is used the oil is poured into the mixer through the flame. The mixture is spread usually in one course, shaped with rakes and immediately compacted, first with a horse roller and then with a tandem steam roller. If necessary, the surface is reshaped with a road machine before the final rolling.

The best results have been obtained with oil asphalts having a penetration of from 90 to 125; but if the grains of sand are rounded or if the size of the grains varies little, as with ordinary beach sand, a very heavy oil asphalt is best. The most satisfactory results have been obtained by the use of about 16 gal. per cubic yard of loose sand. The depth of cushion should be not less than 4 in. in the center and $3\frac{1}{2}$ to 4 in. at the sides. A seal coat should always be applied, using about $\frac{1}{2}$ gal. of fairly heavy hot oil per square yard, with sufficient sand to take up the oil.

In constructing a road by the sand-and-oil layer

method, the subgrade is shaped and the sandy places hardened. One and one-half gallons per square yard of a fairly heavy hot oil is put on in two applications, or 2 gal. in three applications. Sand is spread after each application and the surface compacted with a horse roller. If only $1\frac{1}{2}$ gal. are used, it will probably be necessary to apply about $\frac{1}{2}$ gal. the following season.

The methods followed in constructing bituminous-gravel surfaces are similar to those described for sand and oil mixtures, except that a larger proportion of bituminous material is used. With these surfaces a base of gravel or broken stone is used and the mixed wearing course is from 2 to 3 in. thick after rolling.

MUCH PENETRATION WORK DONE

The Massachusetts commission has, to a large extent, substituted the penetration for the mixing method on account of its lower cost, though there are certain advantages in the latter. The so-called double-penetration method has also been used to some extent. Under this method the wearing course is formed by successive layers of stone, with an application of bituminous material between each course and with a seal coat. Another method of penetration has been to mix sand with the bituminous material before it is applied. This method gives good results, but the surface is usually not quite as even as ordinary penetration work, and the first cost is greater. The results so far indicate that the surface will last longer, that resealing is not necessary so often, and that the cost of maintenance will be less. This method is not practicable except where proper sand is available.

MANY ROADS RECEIVE ONLY OIL TREATMENT

The Massachusetts commission has abandoned, generally, the heavy for the lighter grades of oils and tars for surface treatment. It is the general practice to use for the first treatment about $\frac{1}{2}$ gal. of oil with a viscosity of between 40 and 50 sec. at 100 deg. C. (Lawrence viscosimeter). The second season about $\frac{3}{8}$ gal. of oil with a viscosity of about 100 sec. should be applied, and the third season from $\frac{1}{6}$ to $\frac{1}{4}$ gal. of a similar oil. After the second or third year, $\frac{1}{6}$ gal. of oil with a viscosity up to 200 sec. can be used to good advantage. A combination of light and heavy oils has also been tried, the method being to form, with light oil, a thin coating thoroughly bonded to the road metal and then to apply about $\frac{1}{4}$ gal. of hot oil with a viscosity of about 600 sec.

The methods of applying and maintaining tar blankets are similar to those for oil, but tar does not take up as much sand, and hence does not form so thick a blanket. While tar does not tend to bunch as readily as oil, it requires more frequent and heavier treatments.

Earth Road Maintenance Is a Problem of Organization

By R. L. MORRISON

Professor of Highway Engineering, Agricultural and Mechanical College of Texas

IN the maintenance of earth roads, which still constitute nearly 90 per cent of our entire road mileage, the first operation should consist of shaping up the road and clearing it of organic detritus with a grader. Under ordinary conditions this should be done once or twice a year. Organic detritus not only makes a poor road surface, but it washes to the sides and hastens the growth of sod and weeds, which seriously interferes with proper drainage. In shaping up the road enough material should be moved toward the center to build up a proper crown. A steeper crown than 1 in. per foot of width forces all traffic to follow in the same track.

The proper use of a road drag is so generally understood that it should hardly be necessary to discuss it. The road drag is endowed with neither brains nor judgment, however, and if these are not possessed by the operator, good results are not to be expected. The almost pathetic sight of a split-log drag stirring up clouds of dust on a perfectly dry road is occasionally encountered. As a result local officials assert that they have tried dragging and found that it is not worth while.

GOOD ORGANIZATION A NECESSITY

The problem of maintenance is mainly one of organization, and in most parts of the United States the old system of working out road taxes is still firmly implanted. However, if the work is carefully planned ahead, the road hands called out a few at a time, and worked under experienced foremen who are continuously employed, the results are improved.

In many states contracts are made with the farmers to drag the roads near their farms at a certain rate per mile or per hour. If a county is divided into districts, the farmers can be called at the proper time and the road dragging will then interfere very little with regular work. If the district foremen are regularly employed and supplied with teams, tools, and extra helpers as required, their work, supplemented by the dragging done by the farmers, will keep the road in excellent condition at a comparatively low cost.

Another system which seems to be efficient is a part-time patrol system, under which the roads are divided into short sections and a man supplied with the proper tools is put in charge of each section. He does not devote his entire time to the care of the road, but his other employment is made secondary to the road work.

PATROL SYSTEM BEST ON GRAVEL ROADS

The gravel road probably ranks next to the earth road in total mileage. On many trunk highways a gravel surface would be entirely unsatisfactory, but on roads carrying comparatively light traffic the annual interest cost of a more substantial pavement may exceed the maintenance cost of gravel. With this type of road the regular patrol system seems to be the most economical and efficient. A small hole in a gravel road, unless immediately repaired, soon becomes a large hole. The greatest amount of maintenance work is required during the first few months after the road has been

built. Before it has become thoroughly compacted and settled by traffic, the surface is likely to become badly cut up in wet weather, and to ravel in dry weather. If the gravel contains a great excess of clay it will be necessary to add a thin layer of sand-gravel free from clay. If, on the other hand, the gravel does not contain sufficient clay properly to bind the surface, a layer of clay may be added and harrowed into the gravel. Usually from 10 to 20 per cent of clay makes a satisfactory binder.

CONSTANT ATTENTION CHEAPENS MAINTENANCE

At first the scraping or dragging should be done after every rain. After the first few months a drag will be as effective as a scraper. When the surface becomes so badly worn that patching is no longer sufficient, the road must be entirely resurfaced. This work can best be done in the spring, when the road is comparatively soft. The scarifying can often be done with a heavy harrow. Before the new gravel is put on, the old surface should be well sprinkled and, if possible, rolled. It will add to the life of a gravel road to roll it every spring and after the first rains in the fall. The rolling should be done when the road is fairly soft, but not while water is standing upon it. The dragging and small repairs needed annually cost as a rule from \$20 to \$50, though sometimes \$100 or more, per mile per year. A total annual cost of from \$150 to \$300 per mile should keep the roads in first-class condition perpetually; but an ordinary gravel road does not seem able to carry economically more than about 150 motor cars per day.

Monolithic Brick Pavements Preferred by Cleveland

By FRED R. WILLIAMS

Engineer of Paving, Department of Public Service, Cleveland

CLEVELAND has arrived at monolithic construction for brick pavements through experience with practically all other types that have been built. We believe that we are getting better and more durable brick pavements thereby.

The extent to which the various types were laid during the past season is indicated by the following figures:

	Miles
36 streets—natural sand foundation.....	4.51
13 streets—sand or slag cushion on concrete.....	4.02
75 streets—monolithic (cement-sand and green concrete)...	10.09
Total	18.92

The monolithic types have been laid upon streets up to 28 ft. in width with entire success.

Until 1915 the sand cushion was used between the brick and base. During that year both city and county started to use the cement-sand cushion type, and following that the green-concrete foundation type. Four-inch brick have been used by the city in the green-concrete foundation type, while the county has used both 4-in. and 3-in. brick, depending on the traffic to be served. Since 1900, with few exceptions, cement grout has been used by the city and the county as the joint filler.

Uniformity in mixing the concrete is an important

factor in securing the best results with the green-concrete foundation type. A quaking mix has been found most satisfactory, since this assures enough water for hydrating the cement, making it easy to handle, and at the same time provides a stable support for the brick surface during laying and rolling. In no event should so much water be used that the excess flows to the side of the street, washing with it cement and sand out of the coarse aggregate.

As yet, I have not been able to secure any lower bids for this type of construction in Cleveland than for the cement-sand bedding course type. I think this is due to the fact that contractors, wholly unfamiliar with it, bid higher than necessary to protect themselves against what they feared might prove to be a loss. I anticipate lower bids as they gain confidence and experience with the new type of construction.

Changes in Wood-Block Paving Practice Are Described

By ELLIS R. DUTTON

Assistant City Engineer, Minneapolis

IN the earliest years so-called experts said that the preservative oil for wood-paving blocks had a tendency to distribute itself through the block, and also insisted on the necessity of extracting all the resin from the wood before treatment. To accomplish this last result, steaming was resorted to. While the expected object was not attained, the practice was in itself good and is now incorporated in modern specifications for the purpose of preventing bleeding, to secure a proper distribution of moisture throughout the block and to eliminate expansion troubles traceable to the laying of dry wood.

MANY PRESERVATIVES USED

For a while it was thought that the only point worth while paying attention to was the character of the oil, and all discussion turned about the selection of type. But more recently it has been proved that there are a number of oils or tars that are quite suitable for this use. In fact, the specifications adopted by the American Wood Preservers' Association permit the use of water-gas tar, which has no definite relation to creosote.

It has been claimed that the oils used about 1908 would not be stable and remain in the block. In the fall of 1916 we took up some blocks laid in 1908 and extracted the oil. On comparison with the original oil it was found that the residue above 355 deg. Fahr. was raised 3 points and the gravity was changed from 1.10 to 1.116. The blocks had lost about 4 lb. of oil per cubic foot, but there was still sufficient remaining in the timber to insure its preservation for a number of years to come. No decay was noted in the pavement.

BLEEDING TRACED TO BITUMINOUS FILLER

Experiments have been made in Minneapolis with the so-called non-bleeding blocks, sections of pavement of this type being laid with sand and others with ordinary pitch filler. The sand-filled sections showed almost no bleeding, only a block here and there showing oil on the surface. Blocks laid with bituminous filler, however, were in quite a bad condition as far as bleeding was con-

cerned, but it is thought that this was due to the filler. In this connection there seems to be no difference in action between pitch and asphalt filler.

Expansion joints at right-angles to the curb line have been given up. These joints were found to be a source of trouble only and served no useful purpose. The angle with the curb at which block should be laid has been the subject of certain experiments in Minneapolis in 1906. The result indicates that blocks laid at 67½ deg. and at 45 deg. show less trouble from joint wear than those laid at 90 deg. The value of one type or another of a pavement is largely economic. As to maintenance, no pavement is cheaper than wood block. It may be said that the average cost of repairs for the past 10 years has not exceeded 0.1 cent per square yard per year, and there is no question as to the wood-block pavement surpassing all others as to noiselessness and low traction resistance.

New York State Concrete-Road Practice Outlined

By H. ELTINGE BREED

First Deputy Commissioner, New York State Commission of Highways, Albany, N. Y.

THE IDEAS presented are based upon the inspection of pavements in various parts of the country, and, more validly, on the actual construction in New York State of 201 miles of second-class concrete pavement of a 1:2½:5 mix, which we have ceased using; and upon the actual construction of 364 miles of cement-concrete pavement, of a 1:1½:3 mix, built in the last four seasons.

GRADES

Our original practice was not to exceed a grade of 5 per cent, but to-day we are building as high as 8 per cent under certain conditions. Grade seems to be limited only by the ability of the wet concrete to run during the process of construction, by the character of the mix and the kind of traffic expected. The use of a coarse sand prevents the road from being slippery, and brooming of the surface facilitates the traction hold of all classes of traffic. Floating should be kept at the minimum, as this operation brings the finer particles to the surface.

Most of the roads we have been building in New York State are 16 ft. in width, because the money appropriated to build our system was on the basis of approximately \$13,000 per mile. Only by the strictest economy, by substituting different classes of pavement within certain limits of cost, and by federal aid can we expect to have all our important roads brought together into a good highway system. It would be far better, however, and ultimately more economical, if we had sufficient funds to build them 18 ft. in width.

CRACKS DUE TO FOUNDATION SETTLEMENT

Cracking of a concrete pavement is due generally to the unequal settlement of the subgrade. If the road is to be satisfactory, it is of first importance that a good subgrade be secured. These we consider the essentials of a good subgrade:

1. It must have uniform bearing power.
2. It must be dry.

3. It should have metal reinforcements (a) under very bad—unequal—soil conditions, and (b) wherever the supporting power of the subgrade changes, as from rock to earth, or passing over a trench.

Our experience indicates that the expense of reinforcement is not justified in gravelly or sandy soils where good natural drainage prevails.

AGGREGATES RECEIVE MUCH ATTENTION

The proportions of fine and coarse aggregate are varied slightly, as a result of field void tests, to obtain the greatest density. Should the size or character of the materials change, there would be a corresponding change in the proportioning of the mixture. We allow, as our maximum size, stone that will pass a 2¾-in. ring, whereas most specifications permit only 1½-in. stone as a maximum. Equally as good, if not better, results are obtained from the larger stone, and at a cost decidedly lessened by using more nearly the product of the crusher.

All sand must meet a definite grading specification, must not contain more than 5 per cent of loam or silt, must develop a compressive strength equal to standard Ottawa sand, and must be free from organic matter or any coating on the grains. There has been a far greater proportion of rejection of sand and stone than of cement.

All our men, from the engineer in charge of the road up, are instructed in all the tests and methods of inspection, and they complete them on every inspection of the work. We believe that our best results may be attributed to the esprit de corps engendered by this method.

CONCRETE IS TESTED REGULARLY

Two 6-in. test cubes are made from every 500 cu. yd. of concrete. They are cured for 21 days in moist sand and then shipped into the laboratory and tested at 28 days. The results of these tests are given to the engineers on the work and the rivalry to have the highest test value produces good results. It is expected that these cubes shall go over 3000 lb. per square inch in compression. Of 504 cubes tested in 1916 only 13¼ per cent were below specification. The causes of these deficiencies were as follows:

	PER CENT	
	1916	1917
Coarse aggregate coated.....	61.9	35
Fine aggregate containing an excess of loam or made up of excessively fine-grained sand.....	25.7	13.9
Coarse aggregate poor quality.....	6.2	8.2
Poor manipulation in making cubes.....	6.2	16.9

Policy of Road Office in Federal Aid Is Taking Shape

By L. W. PAGE

Director, Office of Public Roads and Rural Engineering,
Washington

THE PASSAGE of the Federal-Aid Road Act has served to bring the federal government to the aid of the states through the working out of a great co-operative policy under which the states and the federal government share the expense of road construction.

There is an apportionment of duties and responsibilities which makes the undertaking co-operative in

the fullest sense. The various provisions of the act develop a working plan thoroughly in harmony with this principle and take into account that portion of the undertaking which can best be accomplished by the states and that which can best be accomplished by the federal government. The states select the roads, make the surveys and prepare plans, specifications and estimates, and when the actual work of construction is reached, they directly supervise the work and the maintaining of the roads constructed. To the federal government falls the duty of inspection and approval, that there may be a check and balance provided and that it may be assured that the money it appropriates is properly expended.

The requirement in the Federal-Aid Road Act that the proportion of cost paid by the federal government shall in no case exceed 50 per cent should encourage self-help and discourage insidious paternalism; and it should check insistent and excessive demands upon the federal treasury, because the amount which the states will seek must be limited to the amount which they themselves are in a position to provide.

WHAT IS "SUBSTANTIAL CONSTRUCTION"?

In Section 6 of the act is a provision that the Secretary of Agriculture shall approve only such projects as may be "substantial in character." The department has been asked to announce the classes or types of construction that might be defined as substantial and as to whether grading an earth road would be included. Since there are forty-eight states with every conceivable kind of topography, climate, traffic and other governing conditions, the impossibility of making any definite decision on this point must be apparent. Each state must submit its case and convince the department that the construction which it proposes is substantial in character.

The department in approving a state program can only insist that the provisions of the act are complied with. This has particular reference to whether the routes are all "rural post roads" which are defined as "any public road over which the United States mails are now or may hereafter be transported," excluding certain streets and roads in municipalities. The U. S. Attorney General has been requested to render an opinion which will clarify this definition and establish a definite basis for the determination as to each project that may be submitted.

STATE HIGHWAY DEPARTMENTS MUST BE FIT

Some advocates of local control seem to feel that the highway department should be merely a channel through which the counties and townships may deal with the federal government, but the federal act clearly states that the highway department must be the responsible agent, technically qualified to submit suitable plans, specifications and estimates of cost to the federal government. It must directly supervise all construction done under the terms of the act, and designate the payee who is to receive federal funds. It is not necessary for the state's proportion of the cost of federal-aid roads to be paid out of state funds, nor does the direct supervision required by the act to be exercised by the state highway department involve the award of contracts by the state instead of by the county.

Many of the states leave entirely to the local units the initiative in selecting the roads on which state aid is to be applied and in applying for such aid. This must result in much piecemeal construction, very often to the detriment not merely of the state at large but of the interested localities as well. For example, suppose an important market road passes through the center of County A for a distance of 10 miles, through a corner of County B for 2 miles, and through an important section of County C for 8 miles, making a total of 20 miles. It may readily happen that counties A and C will make application to the state for aid in the construction of this very important highway, but the interest of County B is so slight that it may refuse to apply for state aid, thus leaving an important gap which will serve to defeat the whole purpose of this road construction. The power of initiative should unquestionably be vested in the state highway department.

MUCH DEPARTMENT WORK UNDER WAY

Two amendments to the regulations called for by the act have been adopted: Amendment 1, merely providing that Section 1 of Regulation 6, requiring a project agreement between the state highway department and the secretary to be executed previous to commencement of construction of project, should not apply to projects submitted prior to the issuance of the rules and regulations. Amendment 2 affects Section 8 of Regulation 5 and extends to March 31, 1917, the date within which plans, specifications and estimates may be submitted without conforming to a standard to be prescribed by the secretary.

In each of the ten established districts there is an office under the direction of an engineer. A careful examination has been made as to whether the various states have a highway department within the meaning of the act and as to whether adequate assent has been given to the terms of the act. All but a few of the states have been upheld in their claim. In a few cases it has been found necessary to suggest the advisability of securing additional legislation to broaden the powers of the highway department. A number of the highway departments have submitted their schemes or programs of work, and these schemes or programs are now receiving careful consideration. A number of individual projects have been submitted. Definite approval of them is for the most part delayed until the attorney general announces his opinion as to what constitutes a rural post road, but it is probable that the working season of 1918 will see a large number of important projects actually under way.

Traffic Census Applied to the Design of Roadways

By D. B. GOODSELL

Assistant Engineer, Department of Public Works, Borough of Manhattan, New York City

THE TRAFFIC CENSUS is too little known and used, as yet, to be of much service. Nevertheless, it has a place in the design of country roads, and has loomed up recently with a large and important aspect in great cities. In fixing the width of any roadway surface, the number of lines of traffic to be accommodated should be given consideration. The statement has been

made that, where a vehicle has to turn off a hard surface of a country road on to an earth shoulder oftener than five times in a mile, it is cheaper and safer to construct the additional width of road surface which may be required.

CLEARANCE AND SPEED

The amount of clearance which a vehicle must have to pass other vehicles safely depends on the speed. At 10 miles an hour the width of a single line of auto traffic, including clearance, would be about 8 ft., and at fast speeds, 9 ft. or more. The additional clearance required by an overtaking car should be considered. When moving at, say, 25 miles an hour, at least 4 ft. of free way



Courtesy Fifth Ave. Assoc.

FIFTH AVENUE, NEW YORK, CARRIES SIX LINES OF TRAFFIC

should be given the overtaken car, to avoid accident due to unexpected deflection from its course.

In the Borough of Manhattan, New York City, a realization of the necessity for widening the narrow crosstown roadways of the mercantile district and some of the north and south streets took shape in 1911, and has resulted in the widening of fourteen streets and avenues. On all of these streets a 10-hour census of the vehicular and pedestrian traffic was taken. It was found that the maximum number of vehicles per foot of width per minute should not exceed 0.5, nor the maximum number of pedestrians per foot of width per minute, 5.0.

CHARACTER OF SURFACE IMPORTANT

The influence of the percentage of horse-drawn traffic on the kind of pavement, its grade and alignment, should be given weight. Where more than 75 per cent is auto, sheet asphalt is, in the opinion of the writer, the pavement par excellence; if the traffic is evenly divided into rubber and iron tires, wood block stands out pre-eminently; while if slow-moving horse-drawn traffic amounts to more than 50 per cent of the whole, close-jointed granite blocks are eminently satisfactory.

The tractive resistance of various paving materials

should, in the opinion of the writer, be given much greater weight than is usually accorded them. Auto trucks, in the cities at least, will soon be in almost universal use, and the consumption of fuel will undoubtedly be carefully examined into, and smooth surfaces demanded for economy of operation.

A few figures as to the growth of the auto truck in New York State are presented. It is estimated that auto trucks traveled over state and county highways in 1915, for 40 weeks in the year, 14,700,000 miles, and that those trucks operated 60,200,000 ton-miles.

There were in New York City in 1916 about 21,000 auto trucks, or double the number of 1914.

CENSUS HELPS SOLVE CONGESTION PROBLEM

The traffic census finds its application in the regulation of traffic in large cities where congestion is imminent or actual. The Borough of Manhattan has found it necessary to establish 29 streets as one-way traffic streets. A determination of the amount of traffic in all the streets of any section of a city should indicate where a diversion of the flow is desirable. The writer believes that such studies are highly important, to the end that alternate traffic routes may be laid out.

In the Borough of Manhattan, the Fifth Avenue Association has influenced traffic on that avenue by encouraging merchants and others to exclude commercial traffic from this distinctly retail mercantile and residential thoroughfare, so that there is now less than 2 per cent of horse-drawn vehicles of all kinds. This association makes its own traffic censuses, and studies traffic conditions quite independently of the city.

WHAT THE CENSUS SHOULD INCLUDE

The traffic census should include observations as to the direction of the flow of traffic, such as left-hand turns; number of vehicles emerging from, or entering, side streets; routes of mail trucks and other vehicles; wandering cabs, etc., as well as a knowledge of the various classes of vehicles. The points at which the count should be taken are worthy of study.

Uniformity in methods of taking and recording censuses and in the assignment of weights is much needed, for comparisons in different sections.

Experience with Road-Building Equipment Given

By JOHN H. GORDON
Contractor, Albany, N. Y.

THE contractor's plant and equipment represent his largest fixed investment, and upon their discriminating purchase, intelligent operation and adequate care depends in great measure his success. Scattered, as nearly every road contract is, over 5 or 10 miles of country, it is difficult for the contractor to give concentrated attention to every part of his work and to the proper use of the various large tools. Even men of experience and ability will continue with tools and methods which could be improved if proper attention were given.

Ultimate success depends first on organization and second on plant and equipment. Organization is the more important of the two, for it will be conceded that with an efficient organization results may be obtained

even though the plant and equipment are not of the best. All too often, however, the contractor trusts the expensive machine, relying for results on the judgment of a man whose only qualification is being able to keep up steam.

LARGE TOOLS A CONSIDERABLE ASSET

The contractor's plant and equipment proper consist of the large and expensive tools which are carried on his books as an asset. Conservative management should mark off yearly a material depreciation, but in the lean years this is sometimes omitted, and the contractor deludes himself into thinking his resources are much greater than their actual market value.

The steam roller in general use is the 10-ton double-cylinder model. Where there is sufficient work, the 8-ton tandem roller is an excellent tool for finishing bituminous roads. The life of a roller is indefinite, but with care it will surely last ten years and more. The use of steam shovels on state-road work has been made possible in the past few years by the construction of a shovel of smaller size. Unquestionably there is a material saving in the initial cost of steam-shovel excavation over any other method. A firm with ample capital and doing a large business will find it an excellent tool, but the greatly added wear and tear on the wagons should be considered.

SELECTION OF STONE CRUSHER AND ITS SITE

The stone crushers in general use are of the jaw type, and the size favored is the one with an opening of 10 x 20 or 12 x 20 in. While there are in use some crushers of a considerably larger jaw opening, they are mounted on skids and are satisfactory where a considerable quantity of stone is to be crushed at one location. The nature of the stone to be crushed is also a material factor. The use of one jaw of manganese steel will prove a saving. As at present constructed, the gyratory crusher is suitable only for a stationary plant.

The crusher itself should be set on concrete to reduce vibration, and the approaches should be graded so as to make easy the hauling to the platform of the largest load. Constant lubrication of all parts of the crusher is an absolute necessity. The bin for tailings should be placed on the end and at right angles to the supply bins, so as to have as little interference as possible with the teams or trucks in loading. A 50-ton portable bin may be used to advantage where the output is to be approximately 3000 cu. yd., but for a larger output the 100-ton stationary bin will more than repay the additional cost.

ECONOMY OF POWER HAULING IS DEBATABLE

Most contractors are using one or more motor trucks, with or without trailers. On long hauls over improved roads their value is unquestioned, and for repair work and resurfacing they are economical. Where one truck only is possible, the 3 or 3½-ton is usually more suitable than the heavier, and can be used for more purposes. The traction engine and train is not in as general use as some years ago, but where the quarry or source of supply is a considerable distance from the road, and the connecting roads are unimproved, it is usually economical. The steam roller with not too large a load is one of the best and cheapest forms of hauling. The dump

wagon should be equipped with short poles and rods, easily removable when the wagons are again to be used with teams. Many contractors are using 4 and 5-yd. wagons with tractors.

The use of the fresno is not so well understood in the East, but in the hands of an experienced man, and with teams broken into the work, it is adaptable at a great saving for much of the work of fine grading now usually done with pick and shovel. Contractors in the West are more experienced with this tool, and contracts are done profitably at half of our cost. Though the road machine is used by most road superintendents, it is difficult to find a grade foreman who has other use for it than in trimming shoulders.

The difference in cost between the spout and broom type of concrete mixer is immaterial and the results obtained are largely a personal matter. In building any small concrete work, small portable mixers will effect a great saving in labor. For curb, gutter and edging, steel forms will show a material saving, but they must be properly cared for or they will warp and bend. Special concrete wheelbarrows should always be used and will pay for themselves in a short time. Where the water has to be brought from some distance the use of a gasoline pump and piping is an economy.

Plows, whether roter or grading, should be of the best, as they are the most economical. The points will have to be replaced, but the plow itself should last several seasons. While I do not think the costly shovel is the most economical, since the percentage of lost tools on road work is a consideration, I like the best picks, for there is a great saving in blacksmiths' bills.

Suggests Way to Get "Fat" Garbage for City Plant

As a "health" measure it has been suggested to the Cleveland City Council that the "fat" garbage from hotels and restaurants can be diverted from private reduction plants to that of the city. If it were possible to secure this garbage for the city plant, its earnings would be considerably increased. Therefore Nau, Rusk & Swearinger, certified public accountants, who have been employed not only to perform the regular duties of an accountant but also to suggest constructive criticisms of methods of administration, recommend the following plan:

The City Council could pass an ordinance authorizing it to obtain this garbage by its own garbage-collection department. Many of the wagons of private reduction plants now go through the city streets uncovered. Were the council to pass a "health" measure requiring a city inspector to accompany such garbage wagons to inspect the collection of garbage and charge a fee for the cost of inspection, it would make possible the collection by the city of the garbage from hotels and restaurants. The city collectors could be appointed as inspectors of garbage collected by the garbage department. A sanitary measure along these lines would probably have the approval of the general public. Since the city is under the necessity of dealing with the problem of garbage collection generally, it should have the advantage of rendering this service in the places where it is profitable as well as in the places where it is unprofitable.

Proposes Subway Terminal and Tubes for Cleveland

Project Is Advocated to Relieve Streets So Congested That Street-Car Efficiency Is Materially Lowered

VEHICULAR traffic in Cleveland has increased so much that former street-car headways have been materially reduced. To find out the extent of the present vehicle traffic a census was taken Jan. 20 by the city street railroad commissioner, Fielder Sanders, who gives data in a report submitted to the city council Jan. 25. In this report Mr. Sanders, as a relief measure, proposes a subway terminal and short tube approaches.

The traffic count was made on inbound and outbound traffic at the corners on the edge of the congested business district extending from Superior and West Ninth streets to St. Clair and East Ninth streets, Euclid Avenue and East Fourteenth Street, Prospect and East Fourteenth and the market or Eagle Avenue. In the 4 hours and 15 minutes 5880 automobiles and 1187 wagons passed the outside points into the congested district, Euclid Avenue and East Fourteenth Street leading with 1987 autos and 71 wagons. In the same time 7796 automobiles and 1305 wagons passed these points out of the district, Euclid Avenue and East Fourteenth Street still leading by a great margin. The totals were fairly evenly distributed over the 15-minute periods.

COUNT MADE OF STANDING VEHICLES

During the same period of time, in order to determine the constant condition of the streets, a count was also made of all standing vehicles in the same district. The results showed that 10,056 automobiles and 1236 wagons stood and were parked on the downtown streets, Ontario near the market having the most, and Prospect, Euclid and Superior being close seconds.

In addition to this, during the twelve hours from 6 a. m. to 6 p. m. 3687 street cars came into the square and went out; 1254 cars went around the four Ontario, Prospect, Second and Champlain loops and 33 cars around East Ninth Street. Between 5 and 6 p. m. 613 cars entered and the same number left the square loops at the rate of one every 30 seconds on each track. Out Euclid Avenue between 5 and 6 p. m. there are 171 cars. The street-car traffic has been so delayed by this great excess in vehicular traffic that in order to prevent tie-ups and gaps on the line it has been necessary to increase the running time on several of the lines so that the cars may remain properly spaced.

Mr. Sanders believes that the city should build a subway terminal with short tube approaches under the public square of adequate size to accommodate all the downtown lines. The cost is estimated roughly at \$5,000,000. He would have the work done by the city from a municipal bond issue. As immediate steps to relieve the present conditions it is recommended that some way be devised to distribute the rush-hour evening traffic over a longer period. Advertisements, campaigns of education and agreements of merchants are mentioned. As the tracks in the square are now saturated, he suggests new tracks on the square itself or the running of cars on loops on streets outside of the square.

Making and Filing Valuation Maps—Part I

Requirements of Interstate Commerce Commission Entail Much Work, Which Should Be Carefully Organized—Will Result in Invaluable Uniform Records

By JAMES G. WISHART

Office Engineer, Chicago, Rock Island & Pacific Railway

IN CONJUNCTION with the act of Congress requiring the valuation of common carriers operating in the United States, the Interstate Commerce Commission issued in January, 1914, specifications for maps and profiles to be prepared and filed with the commission by the railway companies. This apparently innocent order has been or will be the cause of an immense expenditure of money by the railroads of the country. A vast amount of drafting work will be required, calling for the services of draftsmen experienced in railway-map drafting. It can safely be said that the act, passed at the time it was, proved a god-send for many an engineer and draftsman, opening up opportunities to earn a livelihood during an especially dull period in railroad-construction work.

This article describes a style of compiling and transposing method of filing the original tracings from which those filed with the commission are copied, of filing the office copies of the filed maps and the organization of the drafting force for carrying on the work.

REQUIREMENTS OF SPECIFICATIONS

The specifications referred to describe in detail the material, scales, symbols and lettering to be used, as well as the character and arrangement of the information to be shown, on the various classes of maps and profiles prepared for filing with the commission. Standard styles of certificates are given and specified information is required in the titles. The method of indexing is also carefully defined and the exact size of sheets is given. It does not require a very extensive study of these specifications to reveal the fact that many of the requirements, including the sizes of sheets and styles of titles, are not in common use by the railroads. The result of this is that of the maps and profiles already in the files of many of the companies but a small percentage are acceptable under the specifications, and will therefore have to be redrawn.

SIZES OF SHEETS

The size of sheets selected by the commission is 24 x 56 in. for all maps and 12 x 56 in. for profiles, with border lines the dimensions of which shall be 23 x 55 in. and 10 x 55 in. respectively. These sizes were apparently selected in order that 4 miles of right-of-way or profile on a scale of 400 ft. to the inch, or 1 mile of station land or track map on a 100-ft. scale, can be shown on a sheet. This with the maintaining of even miles on all sheets, on either scale, is the only argument, to my mind, in favor of this unwieldy and inconvenient size of sheets. It has been fixed, however, by the commission, and the railroads must make the best of it.

There are two methods of filing sheet drawings which are generally recognized as satisfactory—in a vertical file suspended singly or in folios or flat in drawers.

The prescribed size of the sheets practically eliminates the drawer system, owing to the extreme length of the tracings. The modern vertical filing cases are of comparatively recent origin, and consequently have been adopted and installed in very few railroad drafting rooms. In cases where the railroad company is equipped with filing cases which are not suitable for filing on either of the foregoing systems, the question of the best and most economical method of preparing and filing the new tracings is one deserving the most thorough consideration.

The writer has been in close touch with the map and profile work in connection with the valuation on the Rock Island lines, constituting nearly 8000 miles

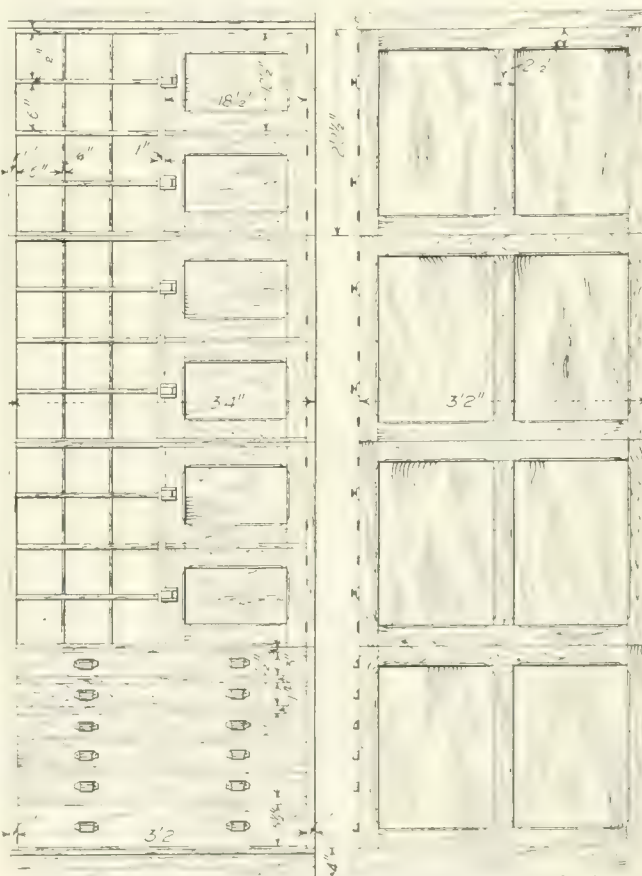


FIG. 1—DETAILS OF FILING CASE FOR MAPS

of line, and the method of filing and sizes of sheets have been carefully studied out, not only with the idea of utilizing the old filing fixtures but also for convenience in handling. In this case it was necessary to make new tracings for more than 6000 miles of line owing to the scale being too small or to the worn condition of the old tracings, some of which were from twenty to thirty years old, so that satisfactory blueprints could not be obtained. The profiles of practically the entire system are being traced over for

the same reasons, and approximately 1500 station plats are being replatted. In addition to these, the index maps for each valuation section and special land maps for a large number of the more important stations were made to fulfill the requirements of the specifications, these latter maps being necessary for valuation purposes only, and being unnecessary insofar as the completeness of the company records was concerned.

The filing cases were of the cabinet type, and designed for filing in rolls on or inside of tubes. These cases were built in units, each unit containing twenty-four compartments, each six compartments covered by a door. The cases are 30 in. deep and the compartments 6 in. square. The construction is as shown in Fig. 1.

The expense of replacing a portion of these cases with a vertical filing system sufficiently large enough

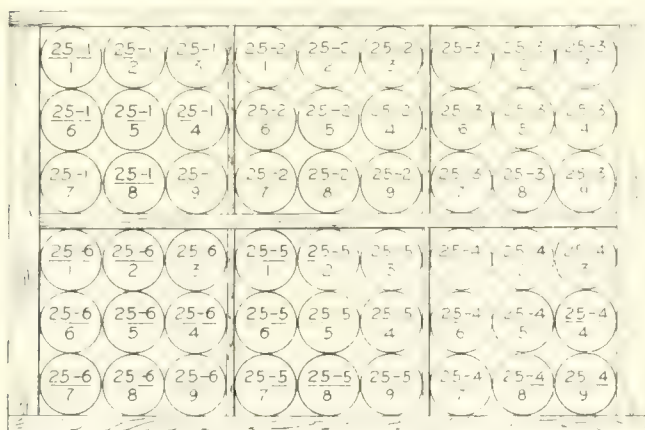


FIG. 2—SYSTEM OF NUMBERING RIGHT-OF-WAY TUBES

to accommodate both the original tracings of the new maps and profiles and the office copies of those filed with the commission was one of the points in favor of the adoption of the system to be outlined. A second and more important reason for adopting this system was to overcome the objections being raised by many engineers to the 4-mile sections of maps, and especially with reference to the profiles. These objections are mainly with reference to the inconvenience of having a number of disconnected sheets to handle when looking over a long stretch of right-of-way map or profile, or a large station map. This is especially noticeable in laying grade lines on a profile, as the break in the profile seldom comes at a convenient point on the grade line, and every engineer has experienced the extra work caused by such an occurrence.

LONG MAP CONVENIENT FOR BLUEPRINTS

Still another item to be considered, which also favors the rolls, is that of making blueprints. Where continuous prints are required, as is usually the case, the separate sheets must be pasted together, thus causing extra labor, loss of time and waste of blueprint paper in the blueprint room. A few years ago, in the days of the small sunlight printing frames, this would not have been considered a serious objection, but the modern continuous electric blueprinting machines add to the desirability of adhering to the system of making these maps and profiles in long rolls, as the labor of making and trimming blueprints from long rolls is reduced to a minimum by the use of these machines.

For the foregoing reasons the new tracings of right-of-way maps and profiles were made in rolls long enough to accommodate an average of 25 miles. The limits of rolls were carefully worked out beforehand for the entire line, and the adopted limits are being adhered to as closely as possible in the making of the tracings. The right-of-way maps are made 30 in. wide, the alignment of the main track being placed along the roll in such a way as to minimize the number of breaks in the map.

STATION MAPS

The station maps are made from 21 to 36 in. wide, depending on the area of territory to be shown, and long enough to show all tracks and other facilities at the station and also to provide for future track extensions of $\frac{1}{2}$ mile at both ends, and in addition leave an extra foot of clear tracing cloth. In the case of the larger towns it was, in some instances, necessary to make the station plat in more than one roll to avoid making too large and cumbersome a map. In such cases a maximum of about 4 miles is allowed to the roll.

The adoption of these sizes for the original tracings, however, can in no way affect the size of sheets to be filed with the Interstate Commerce Commission, which must be according to the specifications, these being made by a lithographic reproduction process, as described later. The impression has been gained to some extent that the original tracings should be made according to specification, in size as well as otherwise. This is not true, and they should be made of the most economical and convenient size.

FILE RIGHT-OF-WAY MAPS IN TUBES

For filing the right-of-way maps, four-ply cardboard tubes capped at one end are used. These tubes are $1\frac{7}{8}$ in. in diameter and $35\frac{1}{2}$ in. long. Each compartment in the filing case holds nine of these tubes, thus accommodating approximately 225 miles of maps. The tracings are rolled tight and filed inside these tubes without rubber bands or other means of fastening to keep them rolled, and the tubes are filled with the capped end out. Fig. 2 shows the typical appearance of the six compartments under one door, with the tubes in place. The six compartments have a capacity of 1350 miles, and a total of 5400 miles will go in one unit of cases.

The most satisfactory method of capping the end of the tubes is by means of a soft wood plug $\frac{3}{8}$ in. thick, set into the end of the tube and fastened in place by four small tacks or brads, or with glue. The outside face of the plug can then be covered with paper for receiving the index number.

MAPS FILED BY STATES

Maps are filed by states, and as far as possible a state is filed complete under one door. This of course must be varied according to the total mileage and the number of branch lines in the state. All or parts of two different branch lines are never filed in one tube, regardless of their length; short lines are given separate tubes, a liberal allowance is made for future extensions on all branch lines and spare tubes are left for possible new lines. For these reasons one state will in some cases require two doors, while in other instances two states may be filed under one door. The doors are

numbered and also labeled with the name of the state and the kind of maps. On the inside of the door is placed a diagram index map for right-of-way maps or profiles and an alphabetical list of station maps with their index numbers. The diagram map shown in Fig. 3 is typical of those used for right-of-way maps.

By referring to Fig. 2 it will be seen that the compartments under each door are numbered from one to six, and the tubes in each compartment from one to nine. The complete index number for a map consists of three numbers. Thus, 25-2-8 represents a map filed under door 25, compartment 2 and tube 8. The complete index number is shown on the capped end of the tube and on the outside or back at both ends of the tracings. This is done for the convenience of the file clerk, who when filing tracings away at the close of the day's work does not have to unroll them to ascertain their number. The complete index number is also shown as a part of the title on the tracing, so that it may be readily identified from prints and accurate reference may be made to it in ordering additional copies. This is especially valuable where the request is made by telegraph. It will be noted from Fig. 3 that only two figures are shown on the index diagram map, these referring to the compartment and tube respectively. The limits covered by each roll are shown plainly on the diagram by station names.

STATION PLATS FILED OUTSIDE OF TUBES

Station plats are filed on the same system as the right-of-way maps, except that they are rolled on the outside of cardboard tubes 1 in. in diameter and 35 in. long, from fifteen to twenty being filed in a compartment. These tubes are made of four-ply cardboard, with a wood plug in each end to carry the index-number tabs and to keep the tube from crushing. To prevent the tracing from slipping off the tube a 6 x 9-in. piece of unprepared blueprint cloth is glued, as a flap, at the center of the tube, this being rolled into the tracing as it is placed on the tube.

Rolling on tubes in this manner requires the use of

ROCK ISLAND LINES

PHILLIPSBURG, KANSAS.

Secs. 22, 26 & 27, T. 3 S., R. 18 W., Phillips Co.

CHIEF ENGINEER'S OFFICE, CHICAGO, ILL., APRIL 1915

SCALE: 1 INCH = 100 FEET

INCORPORATED

INDEX NUMBER 18-2-5

LEGEND

Indicates Rock Island Tracks and Property

PLATTED FROM I. C. C. VALUATION NOTES

FIG. 4—STANDARD TITLE GIVES ESSENTIALS AND OMITTS CHANGEABLE INFORMATION, SUCH AS NAME OF DIVISION

rubber bands as fasteners, which is objectionable. The space available in this case, however, necessitates the use of this method. The extra length of clear tracing cloth left at each end of the tracing, as mentioned above, is of special value where this method of filing is used, as it serves as a protection to the map portion and prolongs the life of the tracing fully 100 per cent. Where plenty of space is available I would recommend that the station maps be filed on the inside of tubes slightly smaller than those used for the right-of-way maps.

In place of the diagram map, an alphabetical list of

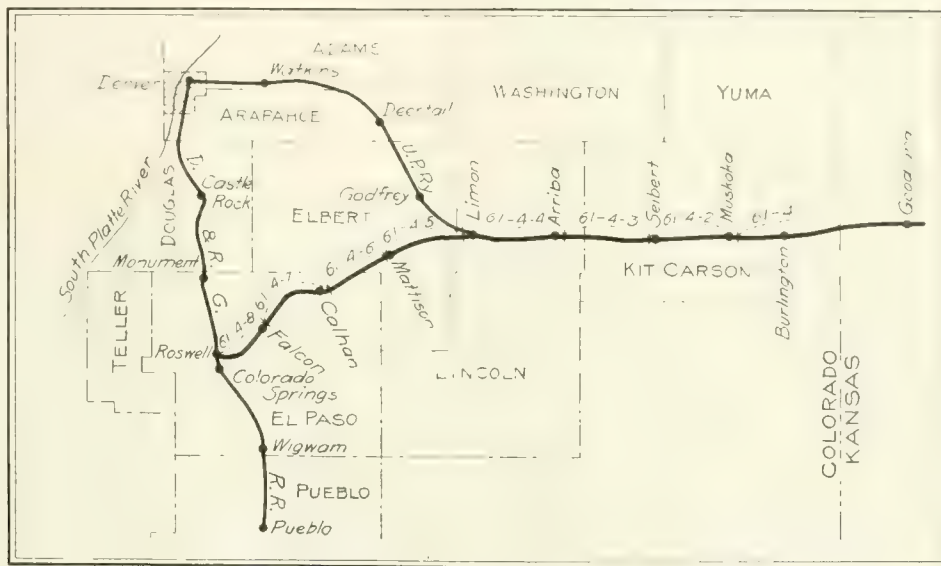


FIG. 3—DIAGRAM MAP IS PLACED ON INSIDE OF DOOR

stations with the index number of each is placed on the inside of the door. The full index number is shown on the ends of the tubes by means of round pasters. These pasters are lightly tinted in colors, tubes for No. 1 compartment in each door being left white, No. 2 being tinted green, No. 3 pink, No. 4 yellow, No. 5 blue and No. 6 brown. This color scheme enables one to see at a glance if a tube is filed out of place, also serving as an aid to the file clerk to prevent his placing the tubes in the wrong compartment. The full index number is shown on the ends of the maps in the same manner as on the right-of-way maps, and is also included in the title on the map.

The title for use on the original station maps is somewhat different from that specified for use on the reproductions to be filed with the commission, and is designed to give all important general information relative to the location of the station. Fig. 4 presents a typical standard station map title.

[TITLE CONCEALED]

Allopathy Versus Homeopathy

The average road builder is continually striving to improve the drainage of his roads, and to keep water away from them, whereas in a dry climate the endeavor is to keep them damp. In Utah, after attempting without success to keep gravel roads in good condition by sprinkling them with watering carts, an experiment is now being made with more drastic methods, the road being drenched instead of sprinkled.

Recent Tendencies in Concrete Construction

Abstracts of Some Papers Presented at the Thirteenth Annual Convention of the American Concrete Institute, Held in Chicago, February 8 to 10

Proportion of New Concrete Industrial Buildings Growing

By W. P. ANDERSON

President, Ferro-Concrete Construction Company,
Cincinnati

AS A RESULT of an investigation made by the author to establish something specific regarding the tendency toward concrete construction for industrial buildings, it appears that this type of construction has made great strides since 1905; while other types have by comparison stood still.

The investigation, undertaken during the past year, covered the collection of data regarding the floor area, type and material of industrial buildings erected during the period from 1905 to 1915 and part of 1916, within what may be roughly classified as the middle states. When inquiry was begun, the writer was unaware of the Portland Cement Association's efforts—later characterized by its chief engineer as "unavailing"—to secure similar statistics. In spite of the difficulties experienced by the Portland Cement Association in its effort to collect data on this subject, the investigation, which had been begun by sending blanks to a selected list of manufacturers in various fields, was continued. The more important industries covered by the inquiry were those of manufacturing metal goods, textiles, paper, leather, boots and shoes, and brewing. Information was also obtained from many other industries too diverse to be classified. More than 1300 replies were received, many of which indicated that no building had been undertaken within the years specified, or gave no information. On the other hand, many of the replies included several buildings.

DATA FOR TABLES

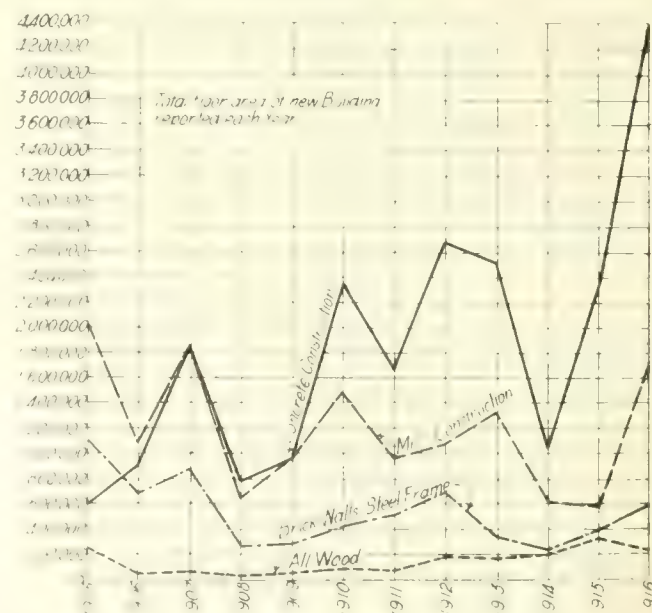
The data from which the table and the diagram were prepared were furnished by 370 concerns and cover 1230 buildings varying greatly in size, use and construction, but all employed for industrial purposes. In many cases the returns indicated construction features which made it difficult to classify the buildings under any of the headings given on the original data sheet, which are those indicated on the diagram. For instance, numerous buildings were reported as "brick walls, mill construction," but with steel frame, while others were specified merely as having brick walls and steel frame, sometimes with wood floors, sometimes with concrete and usually without statement as to the character of the roof. This was noticeable in the case of one-story buildings. However, the chances of improper grouping were generally eliminated by careful analysis of the returns and amplification of the classifications to the nine headings of all wood, concrete throughout,

concrete with steel frame, brick walls with concrete floors, brick walls with steel frame and concrete floors, brick mill construction, brick walls with joist floors, brick walls with steel frame, and miscellaneous.

Such diversified grouping manifestly reduced to a comparatively small number the buildings which fall within each subdivision. The figures for buildings completed during 1916, moreover, cover a somewhat uncertain period of 6 to 8 months, the reports having been made during the late summer. These reports are particularly impressive when compared with those for previous full-year periods. In preparing the curves and the table, the total for 1916 has been taken as 50 per cent more than the reported total. This estimate is thought to be conservative, as the period reported manifestly averaged less than 8 months.

FOUR GROUPS OF DESIGN

For purposes of comparison, so far as the general character of the construction is concerned, it is obviously justifiable to combine the reports as at first listed under the nine headings given above into four comprehensive groups designated as all-wood, mill construction, concrete construction, and brick walls with steel frame. Grouped in this way, the returns shown in the table and the diagram give the totals for each year of the entire period. The first three divisions are reasonably definite, but the fourth division, which is believed to include many one-story buildings, leaves a doubt regarding the material of the roof and floor. The unclassified buildings listed as "miscellaneous" have been omitted.



CONCRETE CONSTRUCTION SHOWS GREAT GAINS DURING PRESENT INDUSTRIAL EXPANSION

FLOOR AREAS OF FOUR PRINCIPAL TYPES OF CONSTRUCTION OF NEW BUILDINGS REPORTED FOR EACH YEAR, 1905 TO 1916

Year	All wood	Mill construction	Concrete construction	Brick walls, steel frame
1905	262,137	2,470,425	617,739	1,117,723
1906	59,700	1,092,566	901,940	700,326
1907	65,372	1,840,754	1,868,769	895,189
1908	31,954	658,232	789,741	271,532
1909	52,808	952,241	974,390	282,427
1910	95,332	1,468,990	2,358,067	434,495
1911	63,691	958,250	1,660,243	513,363
1912	182,308	1,061,828	2,658,554	684,547
1913	166,091	1,329,329	2,500,121	341,013
1914	209,235	612,338	1,010,153	214,984
1915	223,667	572,949	2,375,039	491,958
1916	225,081	1,705,785	4,363,975	585,521
Total	1,728,376	14,723,687	22,078,731	6,533,078

Of course the abnormal disturbances during the last three years account for the great fluctuations within that time. Yet even up to and including 1913 the advance of concrete construction in relation to the other types is distinctly noticeable. Although for a single

How Concrete Ornamental Elevated Stations Should Be Treated

By S. J. VICKERS

Designing Architect, Public Service Commission,
New York City

FOLLOWING the policy of the Public Service Commission of the First District, New York, special treatment has been developed to beautify elevated stations constructed near parks or in important streets in New York City as part of the dual system of rapid transit. These stations, for the most part, are steel structures incased in concrete. The new work ties in with the present Rapid Transit System, giving over 600 miles of single track with a carrying capacity of 3,000,000,000 passengers per annum, and will cost \$350,000,000.

The first specifications of the commission called for concrete of special mix on all outer or exposed surfaces, to be kept from the ordinary concrete by steel shields placed about 2 in. from the outer faces. This method was, however, never used, as it was found that by using Long Island gravel, which contains some dark stones which give variety, and by properly dressing the surface excellent results could be obtained. The shields and special mix were given up, thereby avoiding considerable structural difficulty.

In pouring the concrete care was taken to obtain a uniform mix and work it tightly down against all faces of the forms. Even when extraordinary care is used, certain imperfections will appear after the removal of the forms. In certain places it was necessary to cut these imperfections out to a considerable depth and

fill with a 1:2:4 concrete, the same as the original mix. No dressing was done to the concrete until after it had set at least a month, as it was desired to chip the gravel to give the surface a bright and sparkling appearance. The dressing was done with pneumatic machines, four-pointed tools being used on the greater part of the surfaces, but in certain large fields where a rough surface was desired the bull-point or one-pointed tool was used.

The inside of the forms was given a coat of cheap lubricating oil prepared especially for this purpose. In certain work we were able to have the forms removed within a week; on other work, such as the reinforced-concrete viaduct, it was necessary to keep them in place until the concrete was thoroughly set.

The contractors were required to dress away any unevenness caused by the bulging of the forms, bringing the surfaces to even planes, in which all the cement skin was removed and the gravel lying near the surfaces



QUEENS BOULEVARD ELEVATED—RAWSON STREET STATION IN THE FOREGROUND

year in 1913 concrete dropped while mill construction increased, the former type exceeded the latter by 88 per cent, while in 1916 the excess amounted to 156 per cent. The comparative growth of concrete construction is more plainly brought out, however, by comparing the periods of 1905 to 1910 and 1911 to 1916. In the former, the returns cover 7,014,218 sq. ft. of mill construction and only 5,152,579 sq. ft. of concrete construction. In the latter period, on the other hand, the area of concrete construction jumped 329 per cent to 16,926,152 sq. ft., while mill construction showed a bare increase of 10 per cent to 7,709,469 sq. ft.

Area of Colt's Building Overstated

The figure of 2.8 acres net floor area for the Colt's building, completed to schedule by the Aberthaw Construction Company and described in the Engineering Record for Feb. 3, 1917, page 186, was intended to apply to the entire building, and not to one floor, as stated.

was chipped or cracked to give a sparkling effect. By the removal of a considerable portion of the surface most of the board marks disappeared. It is a curious fact, however, that a few board marks will remain although the entire surface is dressed to a plane, caused probably by the fine sediment collecting about the joints of the boards.

COLORED TILE IN DOMED ARCH CONSTRUCTION

The most unusual piece of construction is the reinforced-concrete structure for Queens Boulevard in the Borough of Queens (see the Engineering Record of Aug. 26, 1916, page 254). A continuous band of colored tile with a plaque on each column was inserted to add color to the gray concrete surface. About 20,000 sq. ft. of tile was used on this piece of construction—probably the largest tile contract of its kind. The tile, selected with great care after considerable investiga-

Should Be Better Relations Between Engineers and Contractors

By C. A. CRANE

Secretary, General Contractors' Association, New York City

ENGINEERS in charge of construction work—the buyers for the public—can effect an enormous saving in other ways than by perfecting economical designs. One of these ways is in perfecting an up-to-date form of contract eliminating the present one-sided and unfair clauses, and including clauses that put a premium on enterprise and good management—"inducement clauses," they might be called—which would attract the many reputable contractors who at present either will not bid on public work or, when they do so, bid extravagantly high. The American Institute of Architects did that very thing a few years ago, and its "standard con-



MOSHOLU PARKWAY STATION ON JEROME AVENUE LINE ERECTED OVER EXISTING BRIDGE

tion, is wet-pressed, hand-made, semi-vitreous, and glazed, with scores of dovetails on the back to insure a perfect bond with the concrete.

Inlaid colored tile is most appropriate as an enrichment for concrete structures. It is not unusual to see concrete structures built in imitation of stone, with cornices, modillions, dentals, string courses, rustications, keystones—all of which may only be done with expensive formwork. How much better to design simply, striving for big surfaces which may be enriched but unbroken by well-placed and well-designed tile.

There is perhaps an analogy in literature to the rich color spots set in the rough exterior "like a rich jewel in an Ethiope's ear." The neglected, raging Lear enters, bearing Cordelia in his arms. "Ha!" we hear him say, "Her voice was ever soft, gentle and low, an excellent thing in woman." We turn from harsh Shylock, who "rather threatened than did promise aught" to Antonio, to listen to the fair and gracious speech of Portia: "The quality of mercy is not strained, but falleth like the gentle dew of heaven upon the earth beneath."

As the great dramatist by way of contrast tempers with pathos the speech of his rougher characters by a gracious word or introduces the melody of a woman's voice, so the designer arranges spots or bands of color in the unyielded surface. In designing concrete, therefore, omit meaningless forms, however appropriate they may be in other materials, and strive rather for large and simple surfaces dressed to a uniform texture, enriched but unbroken.

tract documents" are in universal use on private construction. Whatever benefit accrues to the owner of structures built under this form of contract is due in large measure to the builders, through whose persistent efforts the documents were brought to the present state of perfection.

Do not forget that the owner pays. A pertinent paragraph quoted from a pamphlet issued by the National Association of Builders' Exchanges in a campaign to secure the forms in architects' contracts brings out this point:

"It may be inferred that it is only for the benefit of the contractors that a reform is demanded. The fact should not be lost sight of that the contractor is not the ultimate consumer in the case and that he generally will protect himself from such conditions by a sufficient allowance in his price; it is the owner who must eventually bear the burden."

GOOD ADMINISTRATION REDUCES COST

Unfair clauses, ambiguity in specifications or quantities, lack of inducement—all combine to pile up the cost of work. The personal equation of the engineer, too, is taken into consideration by the contractor in preparing his bid. A prominent contractor, who has built hundreds of miles of the most difficult railroad sections in the country, was speaking of this point just a few days ago. He mentioned two of the big railroad systems which are not many miles apart, saying that when the A., B. & C. road wanted bids he went after

the work hard and bid to get it. But when the X., Y. & Z. railroad let a contract he didn't care whether he got it or not. If he did take the work, his bid was 20 to 40 per cent higher than on the A., B. & C. The engineer on the X., Y. & Z. had the reputation among contractors of being the meanest, most arbitrary and hard-to-suit customer in the country. It cost that road millions of dollars more, said this contractor, to get its work done than was paid by the neighboring road, and for years to come it will pay dearly for the reputation of its chief engineer.

DELAYS IN ENGINEERING WORK EXPENSIVE

Inducements do not mean a letting down of the bars and a free invitation for every Tom, Dick and Harry to come in and run the job to suit himself. On the other hand, inducements are referred to that will be an incentive to good and rapid work—inducements that will not only benefit the contractor but accrue as well to the benefit of the public. For example, suppose the contractor can finish ahead of time, is it advisable for the owner to delay him and make him maintain his plant and force when he could be using them to advantage elsewhere? On one of the large aqueduct tunnels in New York the contract time was 48 months. By good management and improved methods the contractor completed 95 per cent of the work in 26 months. The remaining 5 per cent of the work consisted of the installation of some metal work to be furnished by the city and the placing of some concrete after the metal was in place. The metal was not delivered for 18 months after the contractor was ready to receive it.

In the meantime the contractor had to keep his plant in place, maintain watchmen, pumps and a force to look after the plant, keep his bond in force and lose the interest on the retained percentage, amounting to half a million dollars, in addition to sundry other losses. Eventually he finished the job just within contract time. The only satisfaction he could get was sympathy. Everybody was sorry, but his work wasn't supposed to be done so quickly.

INCONVENIENCE TO PUBLIC

The public paid in this instance, not in increased cost of the work but in inconvenience. The contract extended through the busiest part of the city, and shaft structures and unavoidable street obstructions, maintained an unnecessary length of time, all constituted an injury to business impossible to reckon in dollars and cents.

On subway contracts now building in New York the contractors complain that their working plans have been delayed for months after they were ready for them, thus retarding their progress. It has been asserted that the serious accidents which occurred in two sections undoubtedly would not have taken place had the steel been erected. On those particular sections the steel plans had been delivered to the contractor only shortly before the accidents and nearly two years after the contracts had been awarded. Those accidents cost the contractors some money—and the public paid, too, but their loss was not reducible to money damage.

Contractors for big work assume a big responsibility for the lives of their workmen and for the lives and property of the public. With this and the financial re-

sponsibility incident to the work itself it would seem that the contractor assumes enough without taking on responsibility for acts of the Almighty. Take, for instance, the construction by the government of the compensating dams along waterways that are especially susceptible to floods. The government contracts generally call for a temporary cofferdam to be used in the construction of the work. The contract provides for payment for one cofferdam. If it is washed away, it must be replaced at the contractor's expense, and all other damage caused by the floods must be borne by the contractor.

Because of the inherent gamble in this class of work there are not many contractors in the country anxious to bid, and such as do, make very careful studies of average weather conditions, taking a gambler's chance on them. If the conditions subsequently are more favorable than the average, the contractor makes a handsome profit. If they are worse, as in the case of some recent work on the Ohio River, where eleven heavy floods, some reaching a stage of more than 40 ft. above normal, occurred within a period when not more than one or two floods were to be expected, the contractor loses heavily.

PAYING FOR POSSIBLE FLOODS

It is unfair to the government to have to pay more for the bulk of its work than its reasonable value, and it is certainly unfair to the contractors to have to lose hundreds of thousands of dollars on some of the work through agencies beyond their control. If these contracts should provide a method of payment for flood damage, the government would not be paying a big contingent overhead when there were no floods, and when serious floods occurred the contractor would be reimbursed merely for his loss. Instead of army engineers regarding contractors who do government work as enemies to the flag, they might with profit to the country give some study to a more equitable form of contract.

In pleasing contrast to these contracts under the War Department is the attitude of the engineers of the Navy Department, who are now engaged in just such a study, and as evidence of their announced desire to draft a mutually satisfactory document have invited criticisms of the present forms from contractors and builders, with their suggestions for improvement. This betokens a spirit that, if followed by the engineering profession generally, would go a long way toward bettering the relations between engineers and contractors.

CO-OPERATION CHEAPENS WORK

There is too often, however, the woeful lack of co-operation between engineers and contractors, and this is especially true of engineers of public work. The public's interest is nobody's interest, and work lags and drags in a manner totally absent from construction for railroads or other private utility corporations. One of the most intricate and stupendous pieces of work in connection with the dual subway system in New York was the third tracking of the elevated railroads. This was a \$15,000,000 job, and it was completed in less than two years. The work was designed and done under the supervision of the engineers of the Interborough system and has been in operation for a year, while the

men are still in some of the trenches under city supervision which were started long before the third tracking was begun.

Is it not an engineering duty to reduce this high cost of public work? Some of it—a great deal of it—is caused by too drastic contracts. A great deal more of it is due to delay in proceeding with the work, all of which the contractor anticipates and charges for in his bid. Offer inducements to the contractor to complete his work ahead of time, and the saving, if only in the less inconvenience to the public, will be enormous.

Contractor's Costs Valueless Unless Used by Entire Organization

By LESLIE N. ALLEN

Aberthaw Construction Company, Boston

A SYSTEM of cost accounting, to be of any value to a contractor, must be accessible to and made full use of by everyone in his organization who has anything to do with costs. It is valueless if kept a secret. A proper system of cost accounting, like an expensive machine, is of great worth when working, but an unjustifiable expense if kept idle. The contractor who thinks that his unit costs are a trade secret, the circulation of information regarding which will do him irreparable injury, is making a great mistake. If his costs are higher than his competitors' are, these competitors will lose business if they use them. If his costs are lower, competitors who use them will lose money. It is efficiency, not cost data, that makes for lost costs. The cost data simply point a way to efficiency and show the failures to reach it. For this reason the writer's firm has not hesitated to make public its costs at any time. If this firm makes lower costs than its competitors it is because the firm has the men and the brains needed to do it. Others cannot equal these costs simply because they know them. On the other hand, if these costs are higher than they should be, no one gets any valuable information out of their publication that can give them an advantage.

EMPLOYEES' INTEREST STIMULATED

The concealment of cost data is one of the reasons why it is so difficult to get accurate results. No employee can take intelligent interest in work which is meaningless to him. Many contractors have the labor costs distributed by a timekeeper, who sends them in to the office to be worked up by the bookkeeper in his spare time, the results being seen only by the boss. Neither man understands his work or can show any enthusiasm for it. Neither cares very much whether it is right or wrong, provided that it will "get by." On the work at the writer's firm the situation is exactly the opposite. It is sometimes quite embarrassing to the writer to be called upon to adjudicate in cases where knotty points are being discussed with great earnestness by our timekeepers and foremen, such as whether repairing forms damaged by the strippers should be charged to stripping, erecting or making. The fact that such interest is shown in minor points indicates a real interest in efficient work and low costs all down the line.

The contractor who is not prepared to make his costs

open and accessible is almost as well off without any cost system at all. He is certainly not getting half the return out of it that he should. The contractor's problem in any system of cost accounting is not so to conceal the costs that no one but the boss can get them or understand them, but to make the costs accessible and intelligible to the greatest possible number of people in his organization.

COST DATA CONVERT OWNER TO CONTRACTOR'S WAY OF HANDLING WORK

It is also very desirable that the architect or engineer should have some idea as to the cost of the work which is being done by the contractor under his direction. Many cases have occurred in the experience of the writer's company in which the engineer's knowledge of what the work was costing has led him to allow modifications in the design which save a good deal of money for the clients. If the cost accounts had been concealed, suggestions and arguments regarding a change in the design would have gone unheeded.

On a recent job where the depth of column footings varied owing to bad ground, the engineer desired to build all footings the same thickness and start all columns at the same height, making up the difference in depth between top of footing and bottom of column by a pyramid of concrete, each one of which of course would need separate forms of varying shapes. Instead of arguing on a matter of opinion, we were able after building two or three to demonstrate as a matter of fact that this method was much more expensive than to put additional concrete into the footings, and we were allowed to make the change.

FIVE ESSENTIAL FEATURES OF COST SYSTEM

The first essential feature of a contractor's cost system is the estimate, made for each job and based on the costs of earlier jobs of a similar nature. This estimate should show, first, the quantities, unit costs and total costs of each item of labor, and, second, the quantities and estimated prices of each item of material and each subcontract. The second feature is a daily labor cost report showing the labor costs of each day's work. The third essential feature of such a system is a weekly labor-cost report showing in parallel columns the estimated and actual quantities, unit costs and total costs of the work performed. The fourth feature is a monthly statement of the cost of the materials and subcontracts purchased or ordered, showing in parallel columns estimated and actual costs. The fifth is a final summary made at the close of the job showing the total cost of all labor and material.

The methods used by different contractors to secure such data may vary, but the use made of them should be along the lines outlined below, if the information is to be made really valuable.

ESTIMATE OF USE TO ENTIRE ORGANIZATION

In many offices the estimate is locked up in the safe the day the contract is signed and never sees the light again. The estimate is, or should be, the result of the estimator's study of cost data on preceding jobs, and is therefore the standard set for the cost of the job for which it was made. It should be made in sufficient de-

tail to show in separate items various kinds and classes of work done by different gangs.

The estimate is of use, first, to the general superintendent as a standard of performance by which he can measure the job superintendents and foremen and as a help in organizing and carrying on the work. It is useful, second, to the job superintendent, who needs to see it more than any one. It tells him what he is expected to accomplish.

The estimate is also essential to the purchasing agent, giving him a list of all the items that he has to take care of. From it he prepares a more detailed schedule, and by taking dates from a progress schedule makes up for his own use a list showing all materials required and the dates on which they are needed in order. This enables him to buy intelligently and see that everything is delivered on time. It gives him a valuable check on the bids received, which is especially useful when it happens to be impossible to get more than one or two bidders on an item.

The foremen of the mason, carpenter, concrete and all other gangs should be told what the estimated cost of their work is and should be shown from week to week how their work compares with this cost.

DAILY LABOR REPORTS OF USE CHIEFLY ON THE JOB

Daily labor reports are best prepared on the job, and with a good system reports for the day previous should be in the hands of the superintendent by 9 o'clock in the morning. If each foreman is told what is the estimated cost of the operations he is performing and notified every day as to whether he is keeping within or over-running this cost, it is sure to have its effect. The writer's company frequently plots the principal items on a chart which is posted where not only the foremen but the workmen can see it as they check in and out. The workmen take a cheerful and enthusiastic interest in the vagaries of the wandering line that shows the cost of the work they are doing. If the work is large enough to allow of gangs competing on similar work, such charts are even more valuable.

Costs to be of any use should be fresh and not stale. If the superintendent knows at 9 o'clock the next day that concrete costs 20 cents a yard more to put in than on the preceding day, he can talk it over with his foremen while the matter is fresh and investigate and remedy the fault. If the news does not come to him for a week or ten days after the work in question is done, however, it is too late to do anything. It is not necessary to have these daily cost reports go through the main office in any case, as they come in too often and contain too great a mass of detail to be of much benefit to the general superintendent. Although the job superintendent is usually able to detect inefficient or expensive work by his own experience or observation, these daily costs will point out an occasional high spot that he has missed. They are an unfailing barometer on the job.

WEEKLY LABOR REPORT FOR MAIN OFFICE

The weekly labor report should show in parallel columns the estimated and actual quantities, unit costs, total costs and saving or overrun. The amount of detail may vary in different organizations, but should be sufficient to give an intelligent account of the operations. This statement should go to the officers of the

company as well as to the job superintendents, but for the benefit of the former it should be summarized in a very few items so that the status of the job can be determined at a glance without a lot of study. This statement, which gives a review of the job's operations to date, should also go to the estimator, who needs it to keep abreast of fluctuations in costs.

MONTHLY REPORT FOR MATERIALS

The monthly report should show the estimated and actual costs and quantities of the materials, and the amounts of subcontracts and other expenses incurred. It is not necessary to have a weekly statement of these expenditures, because differences between estimated and actual costs are not due to the way in which the contract is being managed but to errors of judgment in estimating, unexpected rises or falls in the market, lack of information as to local costs and such factors. It is necessary, however, that at least once a month track should be kept of the amounts gained or lost on the estimate.

By adding together the savings or overruns on the labor and materials, the contractor can tell every month just how far behind or ahead of the estimate each job is, and can make an intelligent forecast as to how much can be saved or will be lost on the remainder of the job. Such information is rarely to be found in a contractor's office, but is worth alone almost all the time and expense that could be put in on a cost accounting system.

This statement should, of course, go to the general superintendent and to the job superintendent who are using the materials, to the purchasing agent who spends the money, and finally to the estimator, who finds it a most valuable check on his work.

FINAL ESTIMATE USEFUL ON FUTURE WORK

The final summary of job costs should be made up in the same form as the original estimate and filed for future use. A copy should be given to the job superintendent as a record of what he has accomplished and to the general superintendent as a permanent reference and guide for future jobs. The estimator should, of course, receive a copy, as the final estimates furnish his chief authority for prices used in new estimates.

Road Materials Tested Free

The proper use of the testing facilities which the State of Texas furnishes without charge to its road builders is described in a statement recently issued by P. Nash, testing engineer of the Texas Bureau of Economic Geology. Before any road work is undertaken, he says, a thorough search should be made for all deposits of road materials in the district. Samples of these should be sent to the bureau for testing, and the reports will show what are the best materials. The roads which will best meet the traffic requirements can then be planned, possibly using local material exclusively and possibly with material shipped in by rail. In this way the taxpayers will receive the maximum returns for their money. The plan is precisely that recently advocated by the president of the New York Road Contractors' Association as the fairest for the highway contractors.

Stiffened Floor Insures Smooth Pavement on Queensboro Bridge

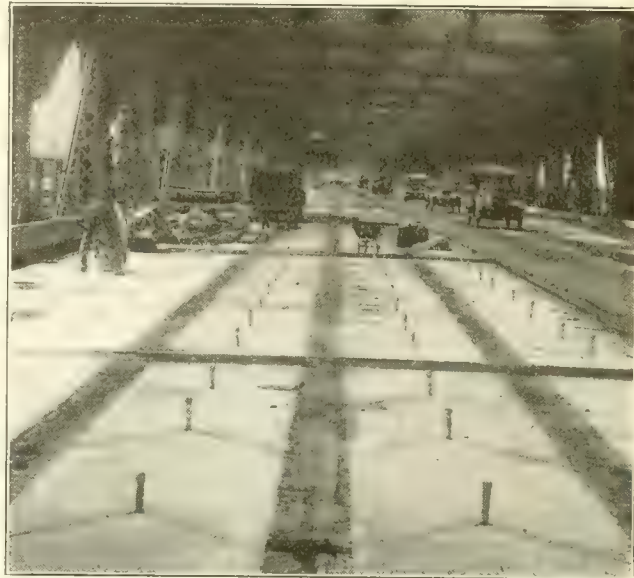
Depressions and Ridges in Original Wood Block Surfacing Were Caused by Deflections of Buckle-Plate Supports and Heaving

BY stiffening the buckle-plates which carry the roadway of the Queensboro Bridge over the East River, New York City, replacing the old 1:3:6 concrete base with a richer mix, providing facilities for the drainage of surface water, and eliminating the sand-cement cushion which supported the original 4-in. creosoted wood block pavement, it has been possible to maintain a smooth surface in place of the ridges and depressions which racked the frames of passing vehicles and made traffic across the bridge a perilous venture. The remodelled floor system, the result of study and experiment by Edward A. Byrne, acting chief engineer of the Department of Plant and Structures, not only insures a paved surface which will not heave, creep or sink in spots, but actually lightens the dead load on the bridge 780 lb. per linear foot. To date, the new paving on the southerly half of the structure has been finished and the work on the northerly half will be begun this spring. Creosoted wood block is used as the new surfacing, but the depth of block has been reduced from 4 to 3 in.

WHAT THE REPAIRS INVOLVE

The repairs involve, also, the placing of a new curb and the removal of two lines of street railway track from the roadway proper to brackets on the sides of the bridge structure. With a length of 7448 ft. 8½ in. and a roadway width of 52 ft. 3 in., the Queensboro Bridge presents a problem involving the maintenance of 43,240 sq. yd. of wood block pavement. Since the bridge was opened on March 31, 1909, traffic has increased enormously. Statistics indicate that the daily average for 1909 was 1170, while the daily average for December, 1916, had risen to 9858 vehicles passing in both directions.

The pavement foundation, as originally constructed, rested on different bases at various sections of the bridge. On one approach the base was of reinforced-

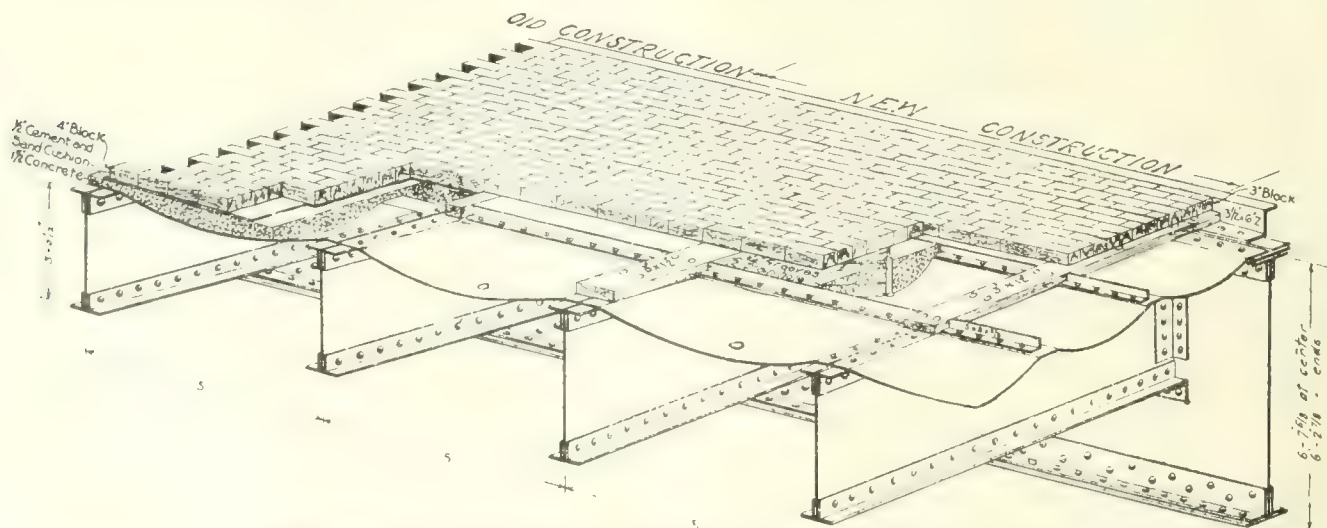


REMODELED FLOOR READY TO RECEIVE WOOD BLOCK

Note transverse Z-bars to prevent creeping, thimbles in drainage channels through buckle-plates and concrete base, and longitudinal timbers over stringers.

concrete, which in turn supported waterproofing protected by common brick on which the 6-in. pavement foundation was laid. On the other approach the concrete foundation, 6 in. thick, rested both on earth fill and on buckle-plate floor. On the main bridge buckle-plates support the concrete foundation. The pavement laid on reinforced-concrete and on earth fill, amounting to 8640 sq. yd., has not required any repair from the time the roadway was opened for traffic in 1909. The part laid on buckle-plates, 34,600 sq. yd., has, according to Mr. Byrne, been a source of constant trouble during the past four years.

In the original construction of the Queensboro Bridge floor, the buckle-plates were carried, buckle down, by stringers spaced on 5-ft. centers. On this floor the 1:3:6 Portland cement concrete base, varying in thickness from 1½ to 4½ in., was laid. A cushion of dry cement and sand, ½ in. in depth, was spread upon the concrete base and creosoted wood block, 4 in. deep, were



COMPARISON OF OLD AND NEW CONSTRUCTION OF QUEENSBORO BRIDGE FLOOR

In the new design, at the right, it will be noted that the buckle-plates are stiffened by angle irons and that timbers are bolted to the tops of the stringers, forming basins in which concrete is deposited. Note drainage hole through concrete. In new work no cushion is interposed between paving blocks and concrete base.

laid upon the cushioned floor at right angles to the center line of the bridge. The joints between blocks were spaced $\frac{1}{8}$ in. and were filled with a bituminous filler free from coal tar and its products.

BUCKLE-PLATES DEFLECT

During the first two years of service this pavement required only slight attention, but under constantly increasing traffic the buckle-plates deflected, resulting in the cracking of the lean concrete base. Over the rigid base provided by the stringers, however, the concrete stood up fairly well. It is quite remarkable, according to Mr. Byrne, to see how the pavement has formed a series of well-defined ridges and valleys over the entire length of the bridge where the buckle-plate type of construction was used. The ridges occur over the stringers and depressions over the buckle-plates. They vary from $\frac{3}{4}$ to 3 in. in depth.

The sand and cement cushion also is said to have been a source of trouble. This cushion never set up hard. There was no provision for draining it, and after storms it became thoroughly saturated. Under these conditions, when a sudden change of temperature occurred, the blocks heaved to heights as great as 3 ft. above the normal surface of the pavement. Then, too, the fact that the cushion failed to do its part in creating a monolithic type of construction formed a shifting base for the blocks so that, with the expansion and contraction of the bridge, the movement of the pavement was further accelerated. On several occasions vehicular traffic over the bridge had to be confined to the spaces occupied by the trolley tracks in order to avoid accident.

FLOOR SUPPORT MADE RIGID

Inasmuch as the trouble was due, not to defects in the wood block, but to the instability of the base, the problem of reconstruction resolved itself into creating a rigid floor support without increasing the dead load



HOW THE STEEL BUCKLE PLATES WERE PREPARED TO RECEIVE ANGLE IRON STIFFENERS



RIDGES AND DEPRESSIONS IN ROADWAY SURFACE WERE FREQUENT BEFORE FLOOR WAS STRENGTHENED

on the bridge. The main features of the revised design are shown in the accompanying isometric drawing. The buckle-plates are reinforced with $3 \times 3 \times \frac{3}{8}$ -in. angles riveted to the unsupported fillets of the plates. Drainage holes in the buckle-plate inverts were punched at the time plates were fabricated. The new base consists essentially of a parquet foundation, formed by a combination of timber planking and Portland cement concrete, with the creosoted wood blocks laid directly on the foundation, without a cushion. On the main bridge yellow pine timber, 14 in. wide and varying in thickness from $2\frac{1}{2}$ to $4\frac{1}{2}$ in. was bolted to each line of stringers by machine bolts spaced 27 in. apart. The heads of the bolts were finished flush with the top of the planks and the countersunk holes around the heads were filled with Portland cement mortar. Portland cement concrete, mixed in proportions of 1:2:4 was laid in the space between the planks and finished flush with the tops of the longitudinal planks. Before concreting began, however, galvanized iron thimbles were inserted in the holes in the buckle-plate inverts so as to form a channel for the passage of water. As a further aid to drainage, diagonal grooves about $\frac{1}{4}$ in. deep and $1\frac{1}{4}$ in. wide were cast in the top surface of the concrete foundation.

BLOCKS LAID WITHOUT CUSHION

In the new work the cement-sand cushion was eliminated and the 3-in. creosoted wood block were laid directly upon the concrete. The joints were filled with sand, as this material proved to be satisfactory and cheap.

In the reconstruction the longitudinal movement of the wood blocks, which was very noticeable in the old pavement, has been checked by the installation of transverse Z-bars at every alternate floor beam. The pavement, therefore, is divided longitudinally into panels from 45 to 80 ft. long, with a rigid support at either end.

The new design of floor and pavement has justified itself, according to Mr. Byrne. Certain sections have been in service over two years and have exhibited no tendency toward heaving or sinking because of insufficient floor rigidity. The Department of Plant and

Structures reports that it is standing up well under the heavy traffic which is increasing at a rapid rate.

BRIDGE LOAD LIGHTENED

Not only has the department relaid pavement and reinforced the roadway floor of the bridge, but it has replaced loose and defective rivets which were found when the old pavement was removed and has replaced bolts by rivets where rivets should have originally been driven in the buckle-plate floor. It has also designed a new curb on the portions of the bridge over the river channels. The redesign of the curb and the new design of the pavement lighten the dead load on the bridge 780 lb. per linear foot. This reduction in weight practically equals the added materials that are being installed for the Second Avenue elevated railroad over the bridge. It is estimated that 130,000 rivets must be driven to complete the work.

An innovation in work of this magnitude is the use of departmental employees for all operations in connection with strengthening the floor system and laying the pavement. The department, under the direction of Commissioner F. J. H. Kracke, purposes to commence the removal of the northerly half of the old roadway next March, if the weather permits. During the winter months the drilling of the holes for the steel angles required in the stiffening of the buckle-plate floor will be continued. With operations thus expedited, it is expected that the roadway pavement will be entirely relaid by next June.

Sprayer Found Superior to Brush for Painting Concrete

Uniform Surface Free from Splotches and Streaks Can Be Readily Produced by Small Hand-Operated Machine

By R. C. HARDMAN
Balboa Heights, Canal Zone

A SURFACE FINISH on concrete far superior to that obtained by the usual method of brushing has been secured by the writer with a small hand-operated paint-spraying machine.

The machine consists of a small hand pump which draws the spraying material from a bucket or barrel, a short hose and a spraying nozzle through which the pump discharges the material. The apparatus is intended primarily for use with cold-water paints, but handles the heavier cement wash without difficulty.

The surface is rubbed with carborundum bricks, or prepared by some other method giving a smooth finish, before the paint is applied. The proper consistency of the material is determined by weather conditions and the kind of surface to be covered. Sand, commonly used in brush coating, should not be used in the mixture. Three men are required for the operation of spraying—one for mixing, one for pumping and another for handling the hose. With this method a much larger surface may be covered by the same number of men than by hand brushing. The surface produced by spraying is of an even, granular appearance, with uniform color, and remarkably free from the streaks and splotches often produced by brushing.

Co-operation of Municipalities Found to Be Practicable

Sewer and Water Problems Can Be Simplified in Urban Communities by Following Metropolitan District Idea, Says Morris Knowles

THE ORGANIZATION of urban communities into metropolitan districts is now regarded both practical and economical in the solution of many of their public-works problems. This, in brief, is the purport of a recent address on "The Metropolitan District Idea," given before the Washington Engineers' Society by Morris Knowles, consulting engineer, of Pittsburgh. Mr. Knowles, who is consulting engineer of the Essex Border Utilities Commission, created by the Ontario parliament for the purpose of forming the seven border municipalities on the Detroit River into a metropolitan district, outlined the operation of the districts at London, Boston and elsewhere. The address was considered of special local interest because of the discussions which have arisen for such a district for Washington and vicinity, looking to comprehensive water-supply and sewage-disposal systems.

COMMUNITY CO-OPERATION

"The need of community co-operation," said Mr. Knowles, "has grown more and more urgent with the growth in concentration of population and with the development of conditions in the Western Hemisphere which have long been prevalent in Europe. Many municipal problems are in no wise limited to the artificial political boundaries, and in many such cases efficiency and economy are secured by central control. Such improvements as water supply, drainage, sewerage, main thoroughfares, park developments and general planning are accomplished much better under united action, and thus haphazard development may be avoided."

Statistics indicate, Mr. Knowles pointed out, that districts surrounding large cities are growing more rapidly than and have problems equally complicated as those within the adjacent urban territory. It is also true that 25 per cent of the population of the United States lives within twenty-five metropolitan districts, which are subdivided into 170 municipal units, each having a population of more than 5000. Therefore the necessity for continuity and commonness of action is apparent. A great benefit that united action will give to the community at large is the prevention of injury to certain urban units, as has frequently been the result when other units, located in the same metropolitan district's area, have treated their problems independently.

SUCCESSFUL ILLUSTRATIONS

The plan has proved successful in the past, said Mr. Knowles, especially in Europe, where until recently the system has been more applicable due to the greater density of the population. Greater London, comprising 530 square miles under the control of the Metropolitan Water Board and containing two cities, thirty-five boroughs, fifty-eight districts and more than thirty-five poor-law unions and parishes, is a typical example. On the North American continent the most important

illustration is that of the Boston Metropolitan Districts in Massachusetts. Here the Metropolitan Park Commission has broad administrative powers over parks and open spaces in the districts of thirteen cities and twenty-six towns surrounding Massachusetts Bay, while the Metropolitan and Sewerage Board has control of the sewerage and drainage of twelve cities and eleven towns covering an area of 190 square miles, with a population of more than 1,000,000, and of the water supply of nine cities and nine towns included within an area of 175 square miles, with a population of 1,250,000. More recently the Metropolitan Fire-Prevention Commission has been organized, having jurisdiction over twenty-two cities and towns, with extensive powers, duties and regulations relative to fire protection and prevention, and the study of fire hazards.

Mr. Knowles pointed out the likelihood of certain

disadvantages of the metropolitan-district idea, such as the occasional lack of complete representation or the apparent development of works ahead of the immediate requirements. However, true community planning, although considering the future in a careful manner, will provide for the building only so fast as is really needed. In matters pertaining to assessments it is desirable that the methods shall not specify too definitely the legislative regulation, as much more satisfactory results can be worked out after the details of the project have been largely determined.

In conclusion, Mr. Knowles stated that it is always possible in any case to work out a method which will be equitable and will give service to each community involved, and that the cost of combined action is far below the sum necessary to treat the problems independently.

Literature

For the Civil Engineer and Contractor

New Publications

A MANUAL OF FIELD ASTRONOMY. By Andrew H. Holt, instructor in civil engineering, College of Applied Science, State University of Iowa. Flexible leather, 4 x 6½ in.; 128 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$1.25 net.

SELLING YOUR SERVICES. Cloth, 6 x 9 in.; 176 pages. New York, The Sales Service Company. \$1 net.

TESTS ON CORRUGATED METAL CULVERTS. Technology Experiment Station Bulletin, University of Maine. Paper, 6 x 9 in.; 15 pages; illustrated. Orono, Maine, University Press.

A TREATISE ON CONCRETE—PLAIN AND REINFORCED. By Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B. Third edition. Cloth, 6 x 9 in.; 885 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$5 net.

CLASSIFIED LIST OF SEARCHES Made in the Library of the American Society of Civil Engineers from January, 1901, to November, 1916. Paper, 6 x 9 in.; 23 pages. Reprint from *Transactions*, Volume 80. New York, American Society of Civil Engineers.

PIPE AND THE PUBLIC WELFARE. By R. C. McWane. Cloth, 5 x 7½ in.; 165 pages; illustrated. New York, The Stirling Press.

PRACTICAL STREET CONSTRUCTION—Planning Streets and Designing and Constructing the Details of Street Surface, Subsurface and Supersurface Structures. Reprinted from the *Municipal Journal*, 1916. Cloth, 6 x 9 in.; 248 pages; illustrated. New York, Municipal Journal and Engineer.

GYPSUM IN SOUTHERN PART OF THE BIG HORN MOUNTAINS, WYOMING.—Bulletin 640-H, U. S. Geological Survey. Paper, 6 x 9 in.; 18 pages; illustrated. Washington, Government Printing Office.

GOLD, SILVER AND COPPER IN ALASKA IN 1915. Mines Report I:8, U. S. Geological Survey. Paper, 6 x 9 in.; 12 pages. Washington, Government Printing Office.

GOLD, SILVER, COPPER, LEAD AND ZINC IN CALIFORNIA AND OREGON IN 1915. Mines Report I:10, U. S. Geological Survey. Paper, 6 x 9 in.; 50 pages. Washington, Government Printing Office.

GOLD, SILVER, COPPER AND LEAD IN SOUTH DAKOTA AND WYOMING IN 1915. Mines Report I:13, U. S. Geological Survey. Paper, 6 x 9 in.; 14 pages. Washington, Government Printing Office.

IRON ORE, PIG IRON AND STEEL IN 1915. Report I:12, U. S. Geological Survey. Paper, 6 x 9 in.; 63 pages; illustrated. Washington, Government Printing Office.

WATER-SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1914. Part 1—North Atlantic Slope Drainage Basins. Paper No. 381, 195 pages; Part 2—South Atlantic and Eastern Gulf of Mexico Basins. Paper No. 328, 66 pages; Part 12—North Pacific Drainage Basins; B, Snake River Basin. Paper No. 393, 248 pages.

ARTESIAN WATER FOR IRRIGATION IN LITTLE BITTERFOOT VALLEY, MONTANA. Paper No. 400-B, 28 pages.

MEASUREMENT OF SILT-LOADED STREAMS. Paper No. 400-C, 12 pages.

ACCURACY OF STREAM-FLOW DATA. Paper No. 400-D, 7 pages.

SURFACE SUBSIDENCE IN ILLINOIS RESULTING FROM COAL MINING. By Lewis E. Young. Bulletin 17, State Geological Survey. Pa-

per, 6 x 9 in.; 112 pages; illustrated. Urbana, Ill., State Geological Survey, University of Illinois.

SPIRIT LEVELING IN TEXAS—1896 TO 1915 INCLUSIVE. Bulletin 637, U. S. Geological Survey. Paper, 6 x 9 in.; 254 pages. Washington, Government Printing Office.

SPIRIT LEVELING IN MISSISSIPPI—1901 TO 1915 INCLUSIVE. Bulletin 639, U. S. Geological Survey. Paper, 6 x 9 in.; 80 pages. Washington, Government Printing Office.

SPIRIT LEVELING IN SOUTH DAKOTA—1896 TO 1915 INCLUSIVE. Bulletin 643, U. S. Geological Survey. Paper, 6 x 9 in.; 100 pages. Washington, Government Printing Office.

SPIRIT LEVELING IN NORTH CAROLINA—1896 TO 1914 INCLUSIVE. Bulletin 646, U. S. Geological Survey. Paper, 6 x 9 in.; 71 pages. Washington, Government Printing Office.

HANDBOOK OF ENGINEERING MATHEMATICS. By Walter E. Wynne, B.E., and William Spraggen, B.E. Limp leather, 4¼ x 6¾ in.; 220 pages; illustrated. New York, D. Van Nostrand Company, \$2 net.

INVESTIGATIONS OF GRAVEL FOR ROAD SURFACING. By T. R. Agg. Bulletin 45, Engineering Experiment Station, Iowa State College. Paper, 6 x 9 in.; 32 pages; illustrated. Ames, Iowa, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts.

U. S. GOVERNMENT SPECIFICATION FOR PORTLAND CEMENT. Circular 33, U. S. Bureau of Standards. Paper, 7 x 10 in.; 43 pages; illustrated. Washington, Government Printing Office.

MANUFACTURING COSTS AND ACCOUNTS. By A. Hamilton Church. Cloth, 6 x 9 in.; 452 pages; illustrated. New York, McGraw-Hill Book Company Inc.; London, Hill Publishing Company. Ltd. \$5 net.

CALCULUS. By H. W. March, Ph.D., and H. C. Wolff, Ph.D., assistant professors of mathematics, University of Wisconsin. Modern Mathematical Texts, edited by Charles S. Slichter. Cloth, 5 x 7½ in.; 360 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company. Ltd. \$2 net.

Books Reviewed

English and Engineering

A volume of essays for English classes in engineering schools. Edited by Frank Aydelotte, professor of English in the Massachusetts Institute of Technology. Cloth, 390 + xix pages. New York, McGraw-Hill Book Company, inc. \$1.50.

An admirable collection of essays, this, with a breadth and keenness of selection that certifies the right of its compiler to occupy the chair of English in one of our greatest engineering schools. Also a most commendable introduction whose ideas are unassailable and remarkably illustrated.

The author is frankly conscious that his work is de-

signed for the teaching of writing to the technical student. In no sense can it be taken as a handbook. It needs the attrition of the class to make its somewhat hidden gold to glisten. To any except those who know writing and its methods, the collection of essays would prove a bewilderment. For there is to be found such variant examples of style as that of Stephenson, who so sharpens the edge of each phrase that no effort is required for insertion, and that of the blustering Carlyle, desirous of no more than weight behind his hammer face. And, too, Arnold Bennett, with "pure" literature's desire to create mood in mind, might lead awry unless more than the indicated emphasis were placed upon "An idea exists in proportion as it is expressed; it exists when it is expressed, and not before."

But to balance these, Cardinal Newman's discourse makes clear that "Thought and speech are inseparable from each other. Matter and expression are parts of one—style is a thinking out into language." Also J. L. Harrington in his "Value of English to the Technical Man" draws the inescapable conclusion that the engineer who cannot speak and write English with clarity and facility is one whose thinking is clouded to the same degree—that he is an uneducated man whose every utterance casts a doubt upon all else that he claims to possess.

But a quotation from the introduction is the fullest explanation of Professor Aydelotte's endeavor, and an index of the pedagogic value of his work: "To train the student to write by first training him to think—to stimulate his thought by directing his attention to problems of his own profession and of his own education and to the illumination of them which he can find in literature: these two tasks may be performed together—better together than separately—and with that double aim in view this collection has been made."

Modern Underpinning—Development, Methods and Typical Examples

Author, Lazarus White, C.E., and Edmund A. Prentis, Jr., E.M. Cloth, 6 x 9 in.; 94 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$1.50 net.

Undoubtedly wonderful advances have been made in the matter of supporting buildings and other structures while adjacent work is carried on which would endanger their security. From the crude methods of 15 years ago, when the usual procedure was to tear up the sidewalk and support the building with rows of timber pushers, to the underpinning methods used in constructing the William Street Subway in New York is a far cry. The old methods invariably damaged the building and interfered with its light and use, while the modern methods are carried on entirely out of sight of tenants and the public, and have been so successful that building after building, weighing many hundreds of tons and ranging up to 21 stories in height, has been underpinned in the course of the construction of the dual subway system in New York City without the slightest accident, and even without settlement.

The authors of this book desired to give the engineering profession, by brief descriptions of general methods and specific cases, and by a series of unusually clear illustrations, an accurate record of some of the best solutions of underpinning problems worked out in

New York City. While the space devoted to the subject in this book is not sufficient to permit of covering the many diverse methods originated to meet various conditions, it can be said that the methods described are among the most valuable and most commonly used, and that the presentation is sufficiently detailed and clear to give a contractor or engineer who has never employed such methods a good idea of how best to do the work.

Tabulated Data Relating to Flow of Water Through Pipes

Author, George T. Prince, C.E. Flexible leather, 4½ x 6½ in.; 149 pages; illustrated. New York, D. Van Nostrand Company. \$2 net.

REVIEWED BY W. E. FULLER

Consulting Engineer, New York City

This book is largely one of tables, showing the results of the author's computations on the flow of water in pipe by using the formulas of Kutter, D'Arcy, Lampe, Fanning, and the exponential formula $H_f = mV^{1.75}$. The discharge of pipes from 4 in. to 120 in. diameter, with varying slopes, is given, as well as the velocity in feet per second, and the corresponding value of c of the Chezy formula.

The author gives his views on the flow of water in pipe, discussing these formulas, together with some others. He also describes the general method of logarithmic plotting. There seems to be little new data on the subject included in the volume, nor has the author made full use of the large amount of experimental data which are available.

The book would be useful to any one wishing a comparison of the above-mentioned formulas with the assumed values of the coefficients which the author has taken.

A Manual of Field Astronomy

Author, Andrew H. Holt, instructor in civil engineering, College of Applied Science, State University of Iowa. Flexible leather, 4 x 6½ in.; 128 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$1.25 net.

This textbook for use in civil engineering courses bases its principal claim upon conciseness, and yet completeness, in its treatment of fundamentals. On the whole, the object of the author has been obtained, and practising engineers who only occasionally have to make astronomical observations will find it especially helpful. The treatment of the oft-times confusing conceptions of the measurement of time is given particular attention, with many illustrative problems solved in excellent form.

In fact, this text has arranged for practical use the already well-known methods found in other sources, which is all that the author claims for it. The illustrations and diagrams are clear and well-conceived, the method of presenting the successive operations is logical and the sample field notes show just how best to avoid confusion and error in the important matter of records. For use with ordinary field instruments there are presented in detail three methods of observation for latitude, five methods for azimuth determination and two methods of observation for time. The main text occupies about 76 pages, the appendices on spherical trigonometry and solar attachments for transits about 14 pages, tables about 12 pages, and the sample field notes 20 pages. The typographical work is good.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Large Concrete Tank Built Up by Plastering Mortar on Reinforcing Mesh

By CHARLES S. KAISER

Kaiser & Miller, North Bend, Ore.

USING successive layers of cement mortar to which 10 per cent of hydrated lime had been added, applied direct to the reinforcing mesh, the writer's company recently built a 17,000-gal. concrete tank without employing any forms for the walls. The floor of the tank is made of 1:2:4 concrete to which 6 per cent of hydrated lime had been added. For the walls, a cement mortar composed of sand running from coarse to fine, mixed with Portland cement, to which 10 per cent of hydrated lime had been added, in the proportion of 1 to 2½, and containing a sufficient quantity of cattle hair, was used. This was applied in successive layers to the reinforcing mesh, which was first erected and supported by 2 x 4-in. studs 14 ft. high. For the lower 8 ft. No. 42 triangle mesh was used and for the remaining height No. 27 triangle mesh. This was wired to the studs, placed outside it. On top of the mesh No. 24 gage Herringbone metal lath was laid horizontally. The mortar was applied in thin coats, each of which was scratched as soon as it had set sufficiently. This process was continued until a thickness of 2½ in. had been built up on the inside of the tank. The last coat was floated, the final wash being applied with a brush consisting of neat cement and hydrated lime.

The outside studs were then removed and mortar applied outside the reinforcing in the same way to a total thickness of 4 in. at the bottom of the tank and 2½ in. at the top. The tank, which has now been in service almost a year, is quite watertight.

The construction method outlined was originated by the writer's firm, which also designed the tank described.

Crane Pulls Over Concrete Piers

By R. T. BROWN

Engineer, Board of Road Commissioners of Davidson County, Lexington, N. C.

IN ORDER to remove some abandoned concrete piers, a pair of which are shown in the photograph, without running the risk of blocking their tracks or damaging overhead wires, the Southern Railway pulled them over with a wrecking crane. These piers were connected in pairs by short concrete girders at the top, both piers and girders being reinforced with ¾-in. steel bars. The piers rested on spread concrete bases buried

under a considerable depth of earth. They were built with the intention of constructing a bridge to eliminate a grade crossing, but objections by property owners to the construction of the large fills necessary to reach the grade of the bridge defeated the completion of the project. As the piers were in the line of the highway and obstructed the view of approaching trains from the road, it was decided to remove them.

Wrecking them with dynamite was suggested, but the plan was not carried out for fear of their falling on the tracks and blocking train service. At the suggestion of a section foreman, it was finally decided to pull them over. The railroad company furnished a work train and equipment for this purpose, the engineer and several laborers being provided by the county.

An attempt was made first to pull over one pair of piers together, felling them away from the tracks, by running a line from the crane to the pier through a heavy snatch block fastened to a large tree. The only result was to straighten out the heavy hook on the snatch block, which sailed away like a clay pigeon and cut a large hole in the tender tank of the work train locomotive. It was then decided to break the girders and pull one pier at a time. A hole was drilled in each girder and loaded with about four sticks of dynamite, sacks filled with sawdust being placed over each shot to avoid breaking signal and telegraph wires about 5 ft. above each pair of piers. Not a wire was injured by either shot.

JIM SMITH, he worked a new idea—a che-ild of his mind—in swinging of a pony truss or something of the kind.

HIS FRIEND Bill Jones, he saw it done, and told it to Ed Brown, who mentioned it months later to a man from out of town.

NOW THAT MAN ran a big bridge shop, we'd like to have you know; he looked up Jim and roped him in, and Jim began to grow.

HE'S THE "OLD MAN" NOW, and in his line they say he's quite a factor.

AN ACCIDENT? Yes—then. But now we've

HINTS FOR THE CONTRACTOR.



PIERS BROKEN APART AND PULLED DOWN BY CRANE

As soon as the girders were broken, the crane easily pulled one pier at a time. They were loaded on a flat car, hauled away and dumped over the side of the high embankment.

It took only little more than half a day to remove these four piers in this way, saving the time that would have been necessary to break the concrete up into small pieces and haul it away in wagons. Moreover, the work was done without danger of blocking the railway tracks. The piers were removed under the supervision of P. H. Lynch, roadmaster, and C. A. Sides, wrecking foreman for the Southern Railway, and of the writer, highway engineer for the county.

"Hydraulic" Bucket Hoist Raises Slag for Building Roof

A "HYDRAULIC" hoist in which the water power was applied by filling and emptying one of two buckets balanced on a rope passing over a pair of well wheels on a frame at the top of the building was used with economy to hoist roofing slag during the construction of a reinforced-concrete building at Keene, N. H., and is described by A. P. Rounds in a recent issue of *Concrete*.

The well wheels were attached to a light wood frame overhanging the edge of the roof and 10 ft. above it. The rope passing over the wheels, to each end of which was attached a 2½-cu. ft. wood bucket, was of such length that when one bucket was on the ground the other would be about 3 ft. above the roof. The bucket used for the slag was weighted so that it would descend to the ground when both buckets were emptied. As soon as the bucket on the ground was filled with slag, the bucket at the top would be filled with water, causing it to drop and raise the slag, which would be stopped at the proper height by the water bucket striking the ground. While the slag bucket was being emptied into a wheelbarrow, the water bucket was emptied into the sewer. The men on the roof then let go of the slag bucket, which swung out over the edge and descended again of its own weight.

The "hydraulic mechanism" for filling the water bucket at the roof level consisted of a 50-gal. barrel placed in a horizontal position near the edge of the roof, and 3 ft. above it with its long axis parallel to the edge. A shaft was passed through the heads slightly off center, the shaft being supported in a frame which allowed the barrel to be revolved freely by a lever secured to one of its heads. Water flowed into the barrel continuously through a ¾-in. pipe under 50-lb. pressure. In the side of the barrel near one head was cut a circular opening to which a sheet-metal spout was attached in such a position that when the barrel revolved the spout would discharge into the water bucket. While the elevator was working the barrel would be turned with the spout up, so that no water was running out. When the slag bucket was filled, the barrel would be revolved until the spout was down, a relatively large volume of water running out of it and filling the bucket in a second or two.

Two men were required to operate the hoist, which averaged a full 2½-cu. ft. load on each trip. The maximum speed attained was two trips per minute, while an average speed of 65 trips per hour was kept up. As the men employed received 25 and 28 cents per hour re-

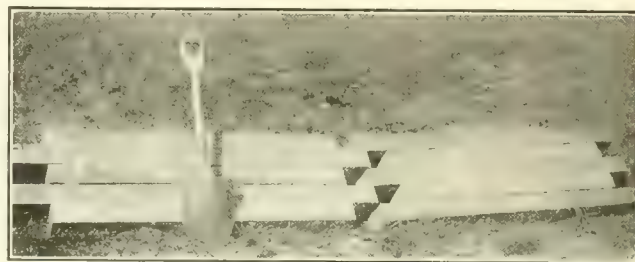
spectively, it is seen that the labor cost of raising this slag was 12 cents per ton, allowing 55 lb. per cubic foot for the weight of the slag. The slag bucket was filled at the bottom from wheelbarrows.

Steam Shovel Turns Easily on Short Sections of Interlocking Track

By EDWARD W. GOLDEN

H. W. Golden & Son, Inc., Troy, N. Y.

INTERLOCKING timber track sections, which could be shifted under the machine in making turns, are being used on the writer's work in handling a 20-ton steam shovel, and have overcome most of the troubles previously experienced in moving and turning. The work on which this revolving steam shovel was being used at the time the runways were devised was in a section where lumber more than 2 in. thick was difficult to secure. In using two or more layers of 2-in. plank trouble arose at the joints, and unless great care



SECTIONS SHIFTED OVER ONE NOTCH TO MAKE TURNS

was taken the wheels were apt to kick the runway out to one side. In going around a curve it was necessary to re-lay the track behind the front wheels for the course taken by the rear ones.

The runways, shown in the photograph, are made of 4 x 6-in. longleaf yellow pine timbers bolted together with thin spacing strips between them by three ½-in. bolts. Two types of track sections, one male and the other female, were used. The length of these sections would vary with the machine under which they were used. Those made for the 20-ton shovel were in lengths forming 4½ ft. of track, which made it possible to change a section between the front and the rear wheels. This is essential in going around the curves. There is enough play in the interlocking joints to take up a section and move it over one notch so that the rear wheel will run squarely on it.

The interlocking joint allowed the wheel to get a bearing on the track section ahead before it left the last one. By placing a short 2 x 8-in. plank under the joint, the shovel could stop and dig with any of the wheels over a joint and still be able to start again without difficulty. Although the timber used in making these runways was a little heavy, it proved very serviceable.

2,500,000 Square Yards of Wood-Block Paving Laid in 1916

Wood block paving to the extent of 2,500,000 sq. yd. was laid on city streets in 1916, it is estimated. Five cities laid more than 100,000 sq. yd. each. In addition about 1,000,000 sq. yd. was laid in factories.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Dumping Platform for Electric Trains Fails

Accident at Disposal Dock for East River Tunnels, New York City, Costs Two Lives

The breaking of strap steel stirrups, in which two 24-in. I-beams from which a dumping hopper for electric trains was suspended, precipitated the hopper, one dump car and an electric locomotive to the deck of a scow below, killing two men and seriously injuring another, in the northerly slip of the Municipal ferryhouse at Broad Street and the East River in New York City on the morning of Feb. 12. This slip had been turned over to the Flinn-O'Rourke Company, Inc., contractors for the construction of the four downtown tunnels under the East River for the new dual subway system, and was being used to dispose of rock excavated from the southerly pair of these tubes.

As will be remembered from the article on page 810 of the Engineering Record for June 26, 1915, with which was published a drawing of the hopper structure that collapsed, material excavated from these tunnels was being hoisted by elevator shafts at Broad Street and at Whitehall Street to the level of an elevated structure about 320 ft. long built in front of the Municipal ferryhouse. The muck cars were hauled on top of this structure and through the second story of the ferryhouse to the northerly slip by electric locomotives operated through a third rail carrying current at 110 volts. Here the cars were dumped into two hopper structures which discharged into barges below. The outermost of these structures was supported on each side by a 24-in. I-beam. The inner ends of the I-beams were framed to the ferryhouse structure, while the outer ends were hung in $\frac{1}{2}$ x 6-in. steel stirrups from $1\frac{1}{8}$ -in. diameter rods with turnbuckles attached to the lower flange of a transverse plate girder supporting the roof of the ferryhouse structure. Each I-beam was also supported in the same way by a $2\frac{3}{4}$ -in. diameter rod from the lower flange of a second transverse girder approximately over the center of the hopper below.

The failure occurred early in the morning of a cold day under a live load of about 35 tons, the hopper and connections being designed for several times this load. It has been suggested that, as the straps might have been forged at the job, presumably during cold weather in 1915, one or more of them might have been defective. In each case the strap broke at one of the sharp bends around the lower flange of the I-beam.

Concrete Institute Repudiates Joint Committee Report at Meeting

Slag Aggregates, Cost-Data Publicity, Cast-Iron Column Tests, Road Problems and Building Regulations Treated

Hardly was the ink dry on the report of the Joint Committee on Concrete and Reinforced Concrete before the American Concrete Institute, at its annual convention, Feb. 8, 9 and 10 in Chicago, approved materially less conservative practice. Although the vote to adopt the report of its committee on reinforced concrete and building laws and to pass it to letter ballot was passed by the narrow margin of thirteen to ten, apparently no one of the thirteen could be found at the subsequent meetings who would ask for a reconsideration and remove the apparent discourtesy with which the eight years' work of the Joint Committee is received by the organization which should be more interested than any other. At one meeting a motion prevailed to send out with the ballot all of the data supporting the report, and at another session it was voted to defer for one year the letter referendum.

For the six sessions thirty papers and ten reports had been provided, so that several times vital discussions, such as on the topic mentioned above, had to be curtailed. The attendance of the 270 persons registered varied from a handful to the roomful of more than 100 when concrete road problems were discussed Friday evening.

Building-Law Discussion

The report on reinforced concrete and building laws was presented by the chairman, J. H. Moore, chief engineer of the Turner Construction Company, New York. The report preprinted with a few minor changes was adopted. Several criticisms had been sent in. The regulations called for in the report with reference to flat-slab design differing from those of the Joint Committee were defended by A. R. Lord. He stated that additional data were now available; he felt also that the Joint Committee report regulations were too strict, contained too many arbitrary rules and were too conservative, calling as they do for factors of safety of six or more, while in the proposed regulation they would be cut to four or less. The proposed regulation followed the Chicago code and was found to work out satisfactorily, while every building in Chicago would be condemned by the Joint Committee restrictions.

Prof. A. N. Talbot vigorously defended the latter, and T. L. Condon brought in a table showing that the proposed regulation was identical with

the Chicago ruling as far as total moment is concerned, while the Joint Committee calls for a moment 19 per cent above the Chicago ruling. Considering the difference on allowable stresses the Joint Committee's recommendations require 35 per cent greater strength than the Chicago ruling.

Prof. W. K. Hatt indicated that there would soon be available information from an experimental flat slab of four panels built on the Smulski system at Purdue in November. Ernest Ashton called attention to the fact that the two reports were prepared from different standpoints. The Joint Committee report he considered in the nature of a treatise from the theoretical standpoint, while the other is for the practical purpose of a building regulation.

Ernest McCullough's paper on "Building Codes for Small Towns" ended with the conclusion that this should all be handled by a state code.

Slag Aggregates Good

"Slag and Cinder as Aggregates," the subject of a paper by Sanford E. Thompson, contained the results of tests on three samples of slag made by his office for the Stone & Webster Corporation. The tests at twenty-eight days indicated strength 50 per cent in excess of a gravel concrete, but the porosity of the slag required 15 per cent more cement. Careful examinations in various cities did not, he said, disclose evidences of deterioration where Portland cement had been used, but trouble had been experienced with slag cements. R. L. Humphrey stated that in Philadelphia there had been difficulty in getting slag of the right weight and low sulphur content. Furthermore, there were usually a material shrinkage and a difference when the slag and cement were mixed before and after adding water. He is of the opinion users should go slow until there are more tests.

Mr. Thompson's committee report on concrete aggregates was received as information.

Make Cost Data Public

That cost data are valueless if kept a secret and that contractors should give their costs the widest publicity were the contentions of Leslie H. Allen of the Aberthaw Construction Company in his paper on "Cost Accounting for the Contractor and Its Relation to

His Organization." An extended abstract of this paper appears elsewhere in this issue.

Frank B. Walker in discussion stated that the one thing that makes the contracting business of to-day the hazardous profession it is, and the one thing that has reduced competitive bidding to almost a dead-loss basis, is the limited knowledge of costs possessed by a great many contractors and estimators.

C. A. Crane, secretary of the General Contractors' Association, New York, discussed the relation of the engineer and the contractor. His discussion is also abstracted elsewhere in this issue.

Roads

At the highway session, the most popular meeting of the convention, five papers and a report were presented. The latter, on concrete roads and paving, presented by A. N. Johnson, was adopted and ordered sent to letter ballot. Changes made include the increasing of the coarse aggregate from 1½ to 2 in., and the retention of the one-minute period for mixing as the only requirement.

Mr. Johnson also gave a description of the condition of the Wayne County roads. All but three sections, aggregating less than 3 miles, were in good condition. He gave the details of the three defective strips and how they had been repaired. He does not consider a cracked block defective, and it would not be so considered except for the visual effect of the method of maintenance. Woodward Avenue, one of the first roads built in 1909, has, it is estimated, carried 7,000,000 vehicles.

William M. Acheson, division engineer, New York State Highway Department, gave a general review of the practice in his state of concrete-road construction and maintenance. W. Leroy Ulrich, Connecticut State Highway Department, emphasized the maintenance factors in caring for some 50 miles built by the department in his state.

W. M. Kinney told of new methods developed during the last year—belt finishing, more attention to water, side-loader mixers, hand finishing for wide streets by lutes to stakes, a vibrator used in Dallas and the Baker finisher applied in Detroit. Edward Hines elaborated on the latter in discussion, declaring that a denser, harder and smoother finish could be obtained than by the usual methods.

Test Results

L. J. Mensch was down for a paper on the "Tests of Concrete Columns with Cast-Iron Cores." The time was short, so P. H. Bates, of the U. S. Bureau of Standards, showed photographs of the columns tested to destruction. The idea is that a hooped-concrete column with a cast-iron core will permit material reduction in size, a valuable asset in high-value districts. Ten of the columns, 12¼ in. in diameter and 8 ft. long, were tested and failed at an average stress of 12,000 lb. per

square inch of core area. The columns can, he stated, be made to sustain stresses up to 17,000 lb. per square inch.

Earl B. Smith, associate mechanical engineer, U. S. Office of Public Roads and Rural Engineering, gave further data on the flow of concrete under stress, supplementing information on the same subject presented by him last year, as reported in the Engineering Record of March 4, 1916. From experiments in compression cylinders and on beams Mr. Smith concludes that the law of the flow of concrete is asymptotic and continues at a gradually decreasing rate, yet is an appreciable amount during three or four weeks, after which it continues more slowly for an indefinite period. The natural total shrinkage of dry concrete, with which flow is not to be confounded, is about 0.05 per cent in three months. The total net flow under load, exclusive of shrinkage, may be as great as 0.15 per cent, depending on the time, load and material. The combined flow and shrinkage, then, in a 20-ft. column not reinforced, if loaded to about 800 lb. per square inch, may be nearly 0.5 in. of deformation, and may produce, in a reinforced beam of 20-ft. span fully loaded, a sag of nearly 0.3 inch. Even the much smaller deformations, which Mr. Smith says are inevitable, may produce, if not anticipated and provided for, serious results in the setting of apparatus and machinery and in the alignment of shafting, and may easily cause other parts and members of the structure to be overloaded.

Sewers Get Attention

Sewer-design difficulties due to subways in New York were explained in a paper by Samuel D. Bleich, assistant division engineer, Public Service Commission, New York. The following essentials were given as to the proper design of inverted siphons: Complete separation of sewage, industrial wastes and storm water; simplicity of construction; slow and easy change in direction of flow at entrance and exits; easy curves; elimination of all features tending to obstruct flow, and of all movable parts and mechanical devices; easy access without impairing any of essential features; sufficient area of entrance and discharge openings so as not to cause any backwater, and avoidance of abrupt changes of section or direction.

The committee on concrete sewers, W. W. Horner, of St. Louis, chairman, brought in a proposed specification for monolithic concrete sewers which was received as information.

Chimney Design Needs Attention

Year after year the committee on chimneys has told what it was intending to do. J. W. Lowell, in discussing the report, deplored the apparent lack of design data or scientific treatment of the problem. He is of the opinion that walls should be kept as thin as possible even to allowing for tension in concrete. Reinforcing should be kept near the outside, within 2 in. He suggested

closer study of vent holes in air spaces sealed off from flue to keep the stack cool.

Vibration has been studied during the past year by a questionnaire sent out by the Aberthaw Construction Company. M. C. Tuttle outlined the results, and mentioned heavier construction as the answer to the problem.

Two historical papers will, it is thought, make valuable reference additions to the Institute proceedings—one on "Piles," by Charles R. Gow, consulting engineer, Boston, and the other on "Unit Construction," by John E. Conzelman, civil engineer, St. Louis.

The officers elected for the ensuing year are as follows: President, W. K. Hatt; vice-president, Sanford E. Thompson; treasurer, Robert W. Lesley, of Philadelphia. H. D. Hynds, 30 Broadway, New York, is secretary.

Lane Approves Applications of Topographic Engineers

Applications of ninety-three topographic engineers in the U. S. Geological Survey for commissions in the Engineer Officers' Reserve Corps of the Army have been approved by Secretary Lane. The total number of applications for Army commissions thus far submitted amounts to 80 per cent of the topographic field force of the Geological Survey. The new corps is established in conformity with the general plan now being worked out by the War Department to organize and have instantly available for active service in time of need a large number of specially qualified men.

The topographic surveys and maps made by the Geological Survey are recognized as war necessities, and the Survey is now carrying on special field work in co-operation with the Engineer Corps of the Army to produce military maps. The field engineers of the Geological Survey are all men of special training and wide experience.

Waterworks Association Announces Nominees

The American Waterworks Association has announced the nominees for officers for the year 1917-18. The ballots, which have already been sent out to the members, will be counted April 28, and the result announced at the June convention. The nominees are: President, Theodore A. Leisen and Charles R. Henderson; vice-president, Charles R. Henderson and Allan W. Cuddeback; treasurer, James M. Caird and Arthur A. Reimer; trustees, Beekman C. Little, Henry B. Morgan and W. S. Cramer.

The name given first is in each case that suggested by the nominating committee; in the case of trustees, the first two names. The other names are by petition of twenty-five or more members. John C. Trautwine, Jr., named by the nominating committee for treasurer, declined to allow his name to be used, hence the names appearing for this office are both by petition.

Road-Builders' Convention Opposes Change in New Federal-Aid Regulations

Resolution to Remove Present Restrictions on Use of Patented Materials or Processes Is Defeated at Annual Meeting of American Road Builders' Association

Although opposed on the ground that it destroyed co-operation and hindered State officials in exercising their judgment in the selection of pavement types, that section of the new federal aid regulations governing the use of patented materials or processes on highways to be paid for, in part, by U. S. Government funds was indorsed at the opening session of the fourteenth annual convention of the American Road Builders' Association held in Mechanics' Building, Boston, Feb. 5 to 9, when a resolution calling upon the Secretary of Agriculture to rescind the clause in question was decisively defeated. Following an address in which Logan Waller Page, director of the U. S. Office of Public Roads and Rural Engineering, outlined the policy and program of the United States Government in road construction under the Federal-Aid Act (see page 259), L. D. Smoot, commissioner of public works of Jacksonville, Fla., presented a resolution calling for the elimination of the clause of the rules known as regulation 8, section 4, which reads as follows: "No part of the money apportioned under the Act shall be used directly or indirectly to pay or to reimburse a State, county, or local division for the payment of any premium or royalty on any patented or proprietary material, specification, process or type of construction unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose."

Objections to Patented Materials Clause

To this portion of the Government's policy the first objection was made in a written communication from Col. E. A. Stevens, commissioner of the Department of Public Roads of New Jersey. The section referring to the use of patented materials or processes, according to Colonel Stevens, was adopted after the Association of State Highway Officials had been informed that it would have to stay, in spite of that body's previous unanimous vote advising its omission. The association, on being thus informed, suggested by a divided vote changes providing for competition. Such competition, Colonel Stevens stated, is impossible in the case of meritorious patents under any strict interpretation of the language used. "There are," he said, "some meritorious patents, and their use can be had on reasonable terms by honest and competent road officials. The practical denial of the right to bargain for such use would seem justifiable only on the assumption that State officials are either dishonest or incompetent. Such assumptions do not promote co-operation and teamwork."

F. A. Reimer, county engineer of Essex County, New Jersey, also spoke in opposition to the Federal Government's policy. He said, in part: "It is the most pernicious policy we have, by which you can introduce log-rolling in the governing board after the bids have been received. It will invariably be true that the unpatented material will be lower in price than the patented article and the engineer who has made the recommendation is put immediately at a disadvantage and oftentimes his recommendations are ignored, not because they are not right, but because of log-rolling which has taken place after the bids have been received."

Mr. Page inquired whether the free use of patented materials would eliminate log-rolling.

Another opponent was J. M. Head, chief counsel of Warren Brothers Company of Boston. In a number of States, according to Mr. Head, the laws expressly provide that the final determination of the kind and character of improvement, whether patented or unpatented, shall be determined upon, and specifications therefor adopted, before advertising for bids. The regulation, he said, presumed, in the face of express State laws and State Supreme Court decisions, that bids can be called for on both patented and unpatented articles before selecting the kind of improvement to be made. It assumes, also, according to Mr. Head, that some unpatented article is, in the opinion of the Secretary of Agriculture, "equally suitable" for the proposed construction.

Resolution Is Defeated

Mr. Smoot's resolution requesting that regulation 8, section 4, of the federal aid requirements be rescinded was referred to the committee on resolutions of the American Road Builders' Association, which, at a later meeting, reported unanimously against its adoption. The discussion then was re-opened. George C. Warren, of Boston, whose company controls the Bitulithic type of construction, expressed the belief that if the regulation is allowed to stand, such a State as New York would practically be prohibited from using any patented pavement. Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City, endorsing the action of the resolutions committee, said that it would be "questionable and inexpedient" to urge upon the Secretary of Agriculture the rescission of the clause relating to patented materials. He cited cases in which the City of New York had suffered from a reckless policy in laying patented pavements. The basic consideration in a matter of this sort, Mr. Lewis pointed out, is the protection of the tax-payer and it was his belief that

the tax-payer could best be safeguarded by allowing the clause to stand in its present form. George W. Tillson, consulting engineer to the president of the Borough of Brooklyn, New York City, thought that the opponents of the patented materials clause in the Federal-Aid regulations were hasty in assuming that it would exclude their products. He thought it would be best to wait for a year and see how the matter worked out. It was finally moved by George C. Warren that the report of the committee on resolutions, advising against any change in the existing Federal-Aid Road Act, be adopted. The motion was passed unanimously.

The secretary's figures showed an attendance of between 3500 and 4000 at the convention, this number including guests and representatives of exhibitors. In the arrangement of the program generally one, and never more than two, formal papers were assigned to each session, the idea, as expressed by Colonel W. D. Sohler, being to give ample time for discussion from the floor. The large attendance at the meetings and the interest manifested were an unqualified indorsement of the plan followed. Most of the papers are abstracted elsewhere in this issue and will not be dealt with in this report.

At the opening session, with President Arthur W. Dean presiding, Director Page, of the Office of Public Roads, defended the Federal-Aid Road Act against criticisms of "pork-barrelism." He pointed out that the policy adopted is one which encourages self help and discourages paternalism. From the point of view of the pork-hunter, he said, no measure is attractive which requires the State to contribute an amount of money equal to that appropriated by the Federal Government.

Road Maintenance

In the discussion of Prof. R. L. Morrison's paper on earth and gravel roads (see page 257), the opinion seemed to be unanimous that the patrol system of maintenance is without a peer for these types of construction. One man must be made responsible for each section of road and means must be taken to instill into the maintenance force pride in their work.

The paper by W. R. Farrington of the Massachusetts Highway Commission (page 256) started discussion on the maintenance of bituminous surfaces. A great deal of trouble has been encountered in keeping the shoulders of such roads in repair. R. A. Meeker, chief engineer of the New Jersey State Department of Roads, questioned the advisability of spending money for concrete curbs at the edges of bituminous surfaces. He was of the opinion that these funds could be employed to better advantage in building roads of greater width. No trunk highway, Prof. Arthur H. Blanchard said, should be less than 18 ft. in width.

The Massachusetts Highway Commission, according to Mr. Farrington, has had considerable success with the use of a tar-sand mastic by the pene-

tration method. This treatment is generally applied by hand pouring, hot sand being introduced into cans containing the bituminous material. Unless it is agitated, however, the sand settles and it is hard to maintain the mixture of uniform consistency. Philip Sharples, of the Barrett Company, told of efforts which are being made by his organization to develop a machine for applying this mastic.

Breed Discusses Concrete Roads

A wide variety of questions were answered by H. E. Breed after reading his paper on concrete roads (see page 258). There was a difference of opinion as to the merits of hydrated lime for concrete roads. W. T. Chollar, of the Atlas Portland Cement Company, stated that tests conducted by Henry G. Shirley of the Maryland State Department of Roads, led him to believe that there was no necessity for using hydrated lime, and that a concrete mixture of 1:1½:3 could be depended upon to give good results. The case for hydrated lime, however, was not thus summarily dismissed by E. S. Larned of the Lehigh Portland Cement Company. He called attention to the articles which have been appearing recently in the technical press on the dangers of too much water in concrete. In road work the tendency is to add water until a mixture will flow freely and work readily. It is possible, Mr. Larned pointed out, to reduce the amount of water and, by adding hydrated lime as a lubricant, secure a plastic concrete. The great advantage of hydrated lime, therefore, is that it produces a workable concrete without resort to an excess of water.

The concrete road is to be introduced in France at an early date, according to Mr. Chollar. He told of a French delegation which has just finished an investigation of concrete roads in this country and which, he said, will recommend this type of construction in the rebuilding of France after the war.

Granite Block

William H. Connell, chief of the Bureau of Streets, Philadelphia, described present practice in laying close-jointed granite block pavements. Steel-tired vehicles, he maintained, will soon be a thing of the past, so that one of the chief objections to granite block, noise of traffic, will become inoperative. Cement grout filler is best for granite block pavement, according to Mr. Connell, except in such cases as call for the use of the street by traffic before the grout has had an opportunity to set. Departing from the subject of construction proper, Mr. Connell made a plea for efficient paving inspectors, saying that good ones are worth at least \$10 a day. He presented an elaborate table of paving costs, based on first cost and maintenance charges.

The subject of brick pavements was introduced by a paper by F. R. Williams, paving engineer of Cleveland, Ohio. An abstract appears on page 257. Will P. Blair, of the National

Paving Brick Manufacturers' Association, cited cases to show that a sand cushion is not necessary to protect brick from damage by traffic. In Indianapolis, with the monolithic type of construction, there are no evidences of damage by impact. With the sand cushion, the full value of brick as a paving material cannot be realized. The monolithic type of construction is now recognized as best practice, according to Mr. Blair.

Contractors Discuss Motor Trucks

Contractors had an opportunity to discuss their problems following the paper by John H. Gordon, abstracted on page 260. Much of the discussion centered about the use of motor trucks and teams for haulage. It takes a contractor with a good deal of courage, according to Fred E. Ellis, manager of the Essex Trap Rock & Construction Company, to use a motor truck on new road work. Irregularities of the surface rack the machine and necessitate frequent repairs. On resurfacing jobs, however, the truck is a useful addition to the contractor's plant. Mr. Ellis believes that it is impossible to use both teams and trucks on one job.

Richard Hopkins, contractor, of Troy, N. Y., has found that mixed haulage on road work is possible if the motor trucks are given the right of way. A serious fault in most road work, he believes, is starting the job at the point farthest from the source of supplies. Mr. Hopkins has found it profitable to start work at the one-half or one-quarter point of the section, making it possible to do a good deal of the hauling over a finished road. In such cases, however, the contractor must warn his drivers to break track.

Earth Handling Problems

Eastern contractors apparently have not taken advantage of the Fresno scraper for preparing the subgrade of road. In intelligent hands, this is a most useful tool and, according to Mr. Hopkins, can be operated so as to leave the grade almost in finished condition.

T. J. Rockwood, contractor of Rochester, N. Y., prefers a 3½ to a 5-ton truck for road work. The larger truck, he has found, is unwieldy and in actual practice is seldom loaded to its capacity. There is a disadvantage also in the heavy truck in that it runs up bills for broken bridges and culverts.

Reverting to the subject of drag and wheel scrapers, Mr. Hopkins suggested the following as economical haulage lengths: wheel scraper, 500 ft.; Fresno scraper, 150 ft.; drag scraper, 90 ft.

That road-building is to assume a new importance in Canada after the war is ended was made clear by the remarks of J. Duchastel, city engineer of Outremont, a suburb of Montreal, and president of the Dominion Good Roads Association. Canada is now at work on various colonization schemes for returning soldiers, but a movement is now on foot to organize a vast road-building campaign upon which the men return-

ing from the European trenches will be used in large numbers. The munition factories also must be reorganized and many men will be out of work. Unless Canada adopts measures which will give them employment, said Mr. Duchastel, there will be a move across the border into the United States in search of employment. This condition, Mr. Duchastel stated, must be prevented, for Canada needs her men. Road-building, he said, seems to be the solution to the employment problem after the war.

Traffic was the final subject of the convention and was discussed in a paper by D. B. Goodsell, assistant engineer, Department of Public Works, Manhattan, New York City (see page 260). Mr. Goodsell spoke of congested conditions of the streets in New York City and gave advice as to the selection of the type of pavement with respect to the character and volume of traffic which it will carry. In Massachusetts, according to Col. William D. Sohler, the permissible wheel loading is 800 lb. per inch width of tire, but an effort is to be made to reduce this amount. There is also under way an attempt to limit gross loads to 8 tons.

The entertainment features of the convention included a smoker by the Massachusetts Highway Association, a banquet, and a reception and ball. Moving pictures of the Columbia highway were shown by S. D. Lancaster.

An extensive exhibit of road-building machinery and materials was held in the Mechanics Building. It is described in another column of this section.

Concrete Machines and Cement Products Exhibited

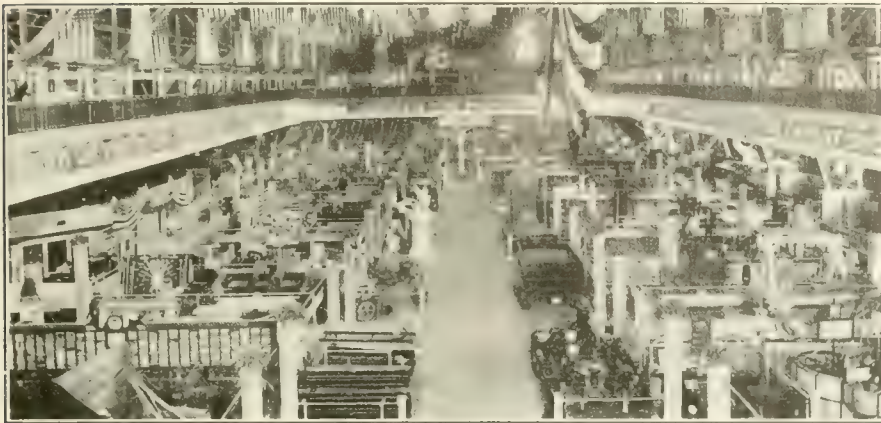
Chicago Cement Show Presented Few Decided Novelties, but Was Replete with High-Grade Standard Outfits

The freak exhibit is no longer seen or heard at the Chicago Cement Show. The tinware mixer man and the man who dealt in secret compounds for producing superconcrete have gone to other places. Perhaps this statement is not completely true, but at the exhibition just ended one had to search far to find a featured device or material not to be commended as truly serviceable to the concrete constructor. The practical serviceability of the exhibits was the broadly outstanding feature of the Chicago Cement Show of 1917.

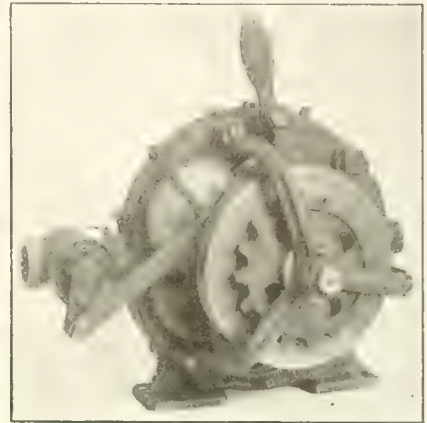
Joint Exhibits a Feature

Two groups of industries, the cement manufacturers and the associated manufacturers of concrete mixers, made joint exhibits. Under the direction of the Portland Cement Association a score of grouped booths at the north end of the building displayed concrete materials and cement products by pictures, models and sample articles. This exhibit served the contractor best, per-

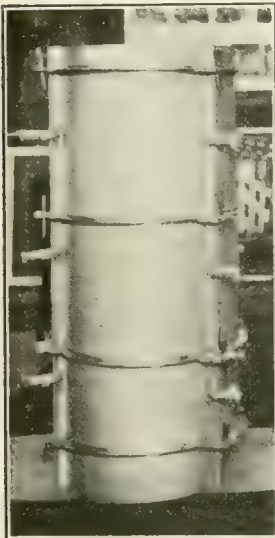
New Machines at Chicago Cement Show



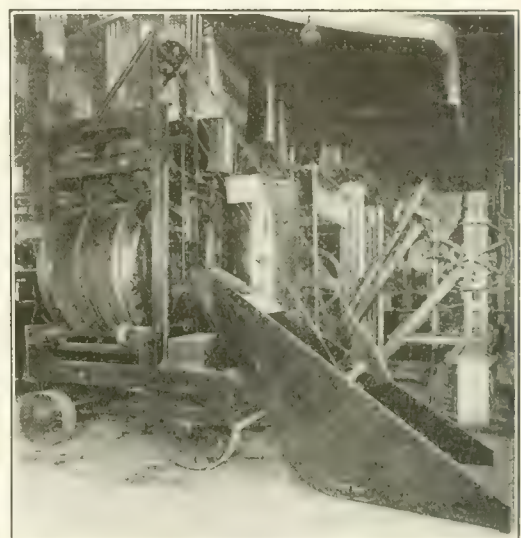
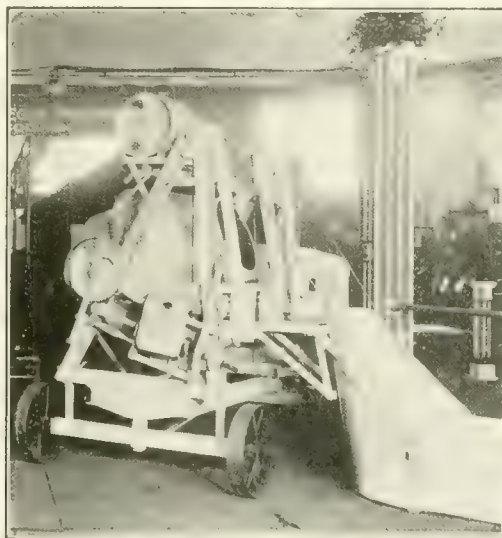
GENERAL VIEW OF CHICAGO CEMENT SHOW OF 1917



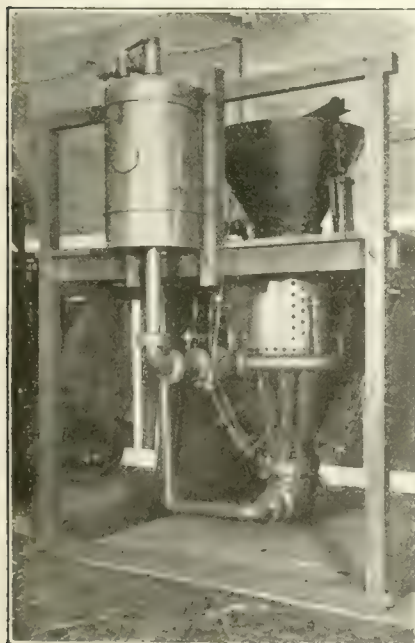
AUTOMATIC WATER REGULATOR



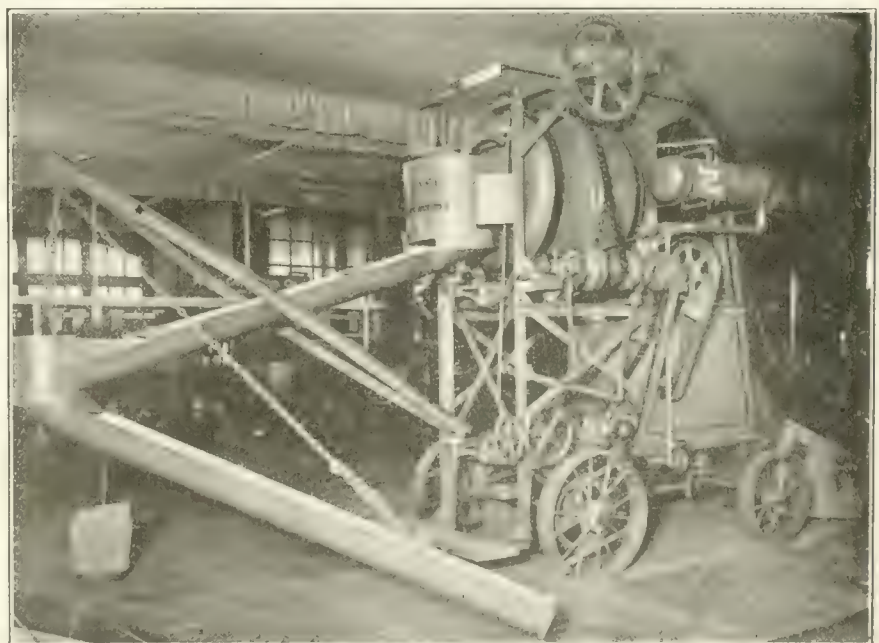
SECTIONAL COLUMN FORM



TWO MODIFIED TYPES OF MIXERS DEVELOPED MAINLY FOR BUILDERS



PREMIXING PNEUMATIC MIXER



NEW PAVING MIXER WITH 16-FOOT HINGED SPOUT

haps, in its illustrations of poor and good aggregates for concrete and of crushing tests of concrete cylinders made from good and poor sand and coarse aggregate. The spectacular feature of the exhibit was a full-size section of concrete road with pictured background and other theatrical properties.

The other grouped exhibit, that of the National Association of Mixer Manufacturers, made up for its lack of scenic appeal by the impressiveness of the machines exhibited. Half a dozen or more large pavers were scattered about the exhibition space.

Pneumatics and the Concrete Worker

Mechanically, the features of the great mixer exhibit were the machines for mixing and placing concrete by compressed air. They ranged from the little truck portable pneumatic stucco placer to the larger "cement gun," the still larger grouting machine and the machines standing 10 ft. tall for mixing and shooting by compressed air half-yard batches of concrete. Air pressure as a means of mixing and placing cement and mortar and concrete mixtures has arrived after a dozen years of active experimentation and increasingly successful use in actual construction.

Comparison is dangerous, but among machines for the concrete worker the mixers made the largest showing. Mention has been made of the large pavers. Quite as significant progress was to be noted in the opposite direction. Small mixers, the little 4-cu. ft. machines, were greatly in evidence. The large makers have turned their attention to the making of mixers of small sizes, and in strength and good mechanical design these little mixers exhibited high qualities.

A hasty count showed a dozen exhibits of motor trucks. These were all machines designed for contractors' haulage, and they made the most notable exhibit of the kind that has appeared at any Cement Show. A brief study showed no radically new developments, but a general improvement in mechanical details and evident effort better to meet the requirements of the contractor in motor-truck construction and operation.

Preparation of Aggregates Featured

Beginning with the exhibit of the Portland Cement Association, which displayed samples of good and poor aggregates, the exhibits of ways and means available for handling and preparing aggregates were numerous. Besides crushers and screens of the types usual to gravel and crushed-stone plants, there were shown various forms of dragline scraper outfits designed for excavating, screening and storing sand and gravel on the job. This last development in the concrete workers' field plant has advanced rapidly during the last two years. Where gravel and sand are locally available contractors for concrete structures will find at hand a number of types of field outfits that

have been well tried out and will meet most conditions of output and cost.

Steel Forms

Exhibits of steel forms for the concrete worker have in the last few years at the Cement Show decreased in number and increased in importance. At the 1917 show few companies showed steel forms, but these firms exhibited comprehensive lines. Steel-form construction as it was exemplified at the recent show presented two salient features. Great advances were shown in standardization of construction and, particularly, in increased adjustability of forms. Column and wall forms, curb and gutter forms and conduit forms in particular are now being made in units, with standard fastenings and bracing, which can be assembled in ways to give various combinations of sizes and shapes.

The feature of the Chicago show of 1917 was not as has been already stated the new machines and devices exhibited, but the higher standards of design, materials and workmanship shown by the old familiar machines. Perhaps half a score would number all the new machines of sizes which were exhibited. In the following paragraphs several of these novelties are described.

Precast and Ornamental Concrete

Ornamental concrete is now firmly established as a practical and economical part of modern construction, and in the joint exhibit of the Portland cement companies and the booths of some of the specialty manufacturers were displayed precast products ranging from column caps to the highly ornate mantel. Of special interest is the degree of perfection attained in the reproduction of stone and marble faces, so true to the natural products as to require close inspection to determine the fact that the objects exhibited were in reality concrete. By the use of crystalline minerals, marble dust, richly colored gravels, etc., effects have been gained of surpassing beauty, and at nominal cost.

As a business getter the Cement Show of 1917 made a record. The visitors included an unusual number of contractors out to investigate concrete machines and to buy.

New Machines

The outstanding feature of the new Rex paver is the location of the drum high enough in the air to get a good angle of discharge with long discharge chutes, doing away with the use of a discharging boom. It cuts down the amount of machinery connected with the machine and makes a gravity mix. The paver is equipped with a 16-ft. lateral spout, the outer 8-ft. extension being swiveled. The whole spout may be turned on a pivot, the outer end covering the entire width of a 30-ft. street. The angle of the spout is 18½ deg. The over-all height is 12 ft. 1¼ in. While the machine is set high in the air the center of gravity is very low, so that

there is no likelihood of the machine tipping over on rough ground. The paver is built by the Chain Belt Company, Milwaukee.

Premixing Pneumatic Mixer

The new pneumatic concrete mixer exhibited by the Ransome Concrete Machinery Company, shown by the accompanying illustration, combines the various features of the Buzzell, Larkin and Caniff patents, developed in connection with grouting and stuccoing devices. The new mixer is made in 1/3, ½ and 1-yd. sizes, the ½-yd. size being best adapted to a large variety of work. The feature of the mixer is the complete mixing of the material in the drum before it is discharged into the conveying pipe. By means of the several jet pipes entering the bottom part of the body, air and water together are forced into and through the materials, producing an active ebullition which mixes them thoroughly. Then the discharge valve is opened and the air pressure in the drum, aided by the jet at the bottom, drives the mixed concrete through the conveyor pipe to the forms, the batch being still further mixed by its travel. The mixer-unit as it is set up on the job occupies a space 8 ft. square. It is 11 ft. high. A 6 or 8-in. delivery pipe is employed. The output depends upon distance of delivery, sufficiency of air pressure and facilities for charging, but up to 700-ft. delivery the ½-yd. machine is capable of a batch a minute.

New "Big and Little" Mixer

A new all-steel mixer of the familiar type built by the Jaeger Machine Company presents two improvements. The improved machine has a hinged power side loader. It is also dumped by power, the dumping operation being under complete control to permit complete or partial discharge. The new mixer, like the others of the same make, is particularly a builders' mixer, and precise control of the discharge permits loading wheelbarrows. Another feature directed to the service of the builder is a hoist connected with the power plant and mounted on the mixer forms.

New Column Form

One of the illustrations shows the essential features of the column form exhibited by the Hydraulic Pressed Steel Company. These features are the shell units, the clamps and the rings. The units are made of 20-gage metal and have a V-shaped edge the full length of each side. These units are pressed in one operation. The units are combined to form the various diameters of columns. When erected, the V-shaped edges fit together, and being all alike, the units are brought into exact alignment and no offset is left on the column to be chipped off when the forms are removed. The V-shaped edge also serves to stiffen the form vertically. Shafts of any height may be formed by using two or more heights of units, telescoping them where the lap occurs.

The units are held together with cast-steel clamps, tightened by means of a bolt and wing nut. The units are held in a circular shape, and the bursting pressure is resisted by circular bands or rings, made of 1½-in. T iron. They are rolled to fit the diameter of the column, and are made in sections corresponding to the width of the units. The rings are assembled in one piece and have one joint left unbolted, so that the ring may be placed on the shaft form. A tool called a ring handle, acting on the lever principle, is slipped into the slots on each side of the joint, and the ring is pulled together, until the wedge slots register. A pointed wedge is then driven through these slots and the ring is brought to the exact diameter. The ring handle is then removed.

Automatic Water Regulator

There was also shown an automatic water regulator for supplying a predetermined amount to a concrete mixer. The meter is in effect a vane pump driven by a sprocket and chain placed on some moving shaft in the mixer. A regulating dial, indicating the amount of water which will pass at a given setting, is revolved by the sprocket through a train of gears until a lever controlling the outlet is released. The clutch is then disengaged until the lever is returned to the set position by the operator.

The meter is rated to discharge from 1 to 20 gal. in a maximum of 10 seconds. It can be connected to a pipe line or it will draw in water from an open tank under a suction lift of 8 ft. if necessary.

The Anderson meter, as it is called, has been tried out for a year on various mixers. It is made by the Municipal Engineering & Contracting Company, Chicago, not only for the company's own mixers but for any style of mixer.

Road Exhibits Show Trend of Present Practice

Paving Materials and Construction Plant Displayed at One Hundred Booths in Mechanics Hall, Boston

With more than one hundred exhibits of road-building material and equipment on display, the Eighth National Good Roads Show, held in conjunction with the annual convention of the American Road Builders' Association, was staged on two floors of Mechanics Building, Boston, last week. The booths on the main floor were devoted largely to paving materials, the lighter types of construction plant and displays by State and municipal highway departments, while in the basement was assembled the heavy road-building equipment—motor trucks, pressure distributors for bituminous material, steam rollers, concrete mixers, tractors, trailers, portable compressors, crushing ma-

chinery, etc. To the throng of visitors which ebbed and flowed through the aisles around the exhibition booths, was afforded an opportunity of studying at close range the numerous types of pavement in use to-day for both heavy and light traffic and the machinery and materials which have been responsible for their development.

The displays on the main floor may be classified roughly under the headings of paving materials, including asphalt, granite, brick, wood block, bituminous forms of surfacing and concrete; construction plant, embracing excavating equipment, drills, pumps, shovels, etc.; and miscellaneous materials, such as steel reinforcement, culvert pipe, road signs, surveying instruments, and expansion joint fillers. In the basement, the exhibits divided themselves under the heads of transportation, construction and maintenance.

Paving Materials

The main entrance to the exhibition hall was flanked by the displays of the Dunn Wire Cut-Lug-Brick Company of Conneaut, Ohio, and the Warren Brothers Company of Boston, showing Bitulithic and Warrenite types of surfacing. In the Dunn exhibit, the monolithic and semi-monolithic types of construction, where the brick is laid either directly upon the green concrete foundation or upon a thin bed of sand-cement mortar, were featured. The Warren exhibit showed models and photographs of Bitulithic construction together with cross sections indicating the grading of the material to produce "inherent stability."

Of the exhibitors of asphalt, the U. S. Asphalt Refining Company featured Aztec products, Bithoslag and Bitosan construction. The Barber Asphalt Paving Company of Philadelphia showed photographs of portable mixing plants, heating kettles, asphalt repair wagons, etc., products of its Iroquois works. Photographs of streets on which their products were laid were shown by the Atlantic Asphalt Refining Company and the Standard Oil Company.

Close-Jointed Granite-Block Construction

Close-jointed granite block construction was illustrated by the Granite Paving Block Manufacturers' Association which had on display sections of pavement showing both bituminous and cement-grout filler for joints and the Compton form of construction, used in Baltimore, whereby a thin coating of asphalt is squeegeed over the surface of granite block and coated with fine gravel.

Bituminous treatment of surfaces was accounted for by the exhibits of the Willite Road Construction Company of New York, the Barrett Company, which had a number of pictures and models of Tarvia work, and the Franklin Contracting Company of New York, featuring National pavement. The feature of the Jennison-Wright Company's exhibit was a slab of Kreolite lug wood

block. This was supplemented by numerous photos of treated wood block for bridge floors and city streets.

The Portland Cement Association featured concrete road construction. Brick of various kinds, impregnated with asphalt, were exhibited by the Aspha-Brick Corporation of New York.

Contractors' Plant

There was a large representation under the heading of contractors' plant and accessory equipment. The Orenstein-Arthur Koppel Company showed a model of an industrial trackage system and cars for hauling concrete aggregate or other material with dinkey locomotives. Steam shovel facts were disseminated from the booths of the Thew Automatic Shovel Company of Lorain, Ohio; the Bucyrus Company of South Milwaukee; the Keystone Driller Company of Beaver Falls, Pa.; and H. P. J. Earnshaw of Boston, who featured Erie steam shovels.

Pumping equipment formed a prominent part of the displays of the Harold L. Bond Company of Boston; the Clinton Power Pump Company of Clinton, Mass.; and the Edson Manufacturing Company of Boston. In the Bond exhibit there were also a portable air compressor and a model of a concrete chuting plant.

Miscellaneous Materials.

Among the displays of accessories to road construction was that of the Lebanon Machine Company of Lebanon, N. H., which comprised several types of cast-iron guide posts with white enameled lettering. The Concrete-Steel Company of New York City featured the Havemeyer bar road mesh, as well as round nose and angle curb bars. The Clinton Wire Cloth Company of Clinton, Mass., showed a full-size section of concrete road reinforced with its wire mesh. Culverts formed the most prominent part of the display by the Cast Iron Pipe Publicity Bureau of New York City.

Engineers have come to realize that the location of a road ranks in importance with its construction. For the locating engineer, the exhibit of W. & L. E. Gurley contained much of interest. There were transits ranging from the heavy to the light mountain type, levels, stadia rods, level rods and for those highway engineers interested in the preparedness movement, one of the latest designs of military sketching boards.

Two types of pre-molded bituminous filler for joints in pavement were shown by the Phillip Carey Company of Cincinnati, with its Elastite joint, and the Asbestos Protected Metal Company, of Pittsburgh, showing the Pittsburgh paving joint. The adaptability of the Pittsburgh joint material for wide variations in temperature was indicated by two specimens of the materials, one immersed in a brine mixture at 30 deg. Fahr. and the other in hot water. The hot specimen maintained its shape while the cold specimen exhibited no signs of brittleness.

A Few of the Exhibits at the National Good Roads Show



1—STANDARD OIL COMPANY, NEW YORK. 2—BARBER ASPHALT PAVING COMPANY, PHILADELPHIA. 3—ACME ROAD MACHINERY COMPANY, FRANKFORT, N. Y. 4—GOOD ROADS MACHINERY COMPANY, KENNETT SQUARE, PA., AND METROPOLITAN PAVING COMPANY, CLEVELAND. 5—ATLANTIC REFINING COMPANY, PHILADELPHIA. 6—HAROLD L. BOND COMPANY, BOSTON. 7—THE ENGINEERING RECORD, NEW YORK. 8—ASBESTOS PROTECTED METAL COMPANY, PITTSBURGH. 9—WYOMING SHOVEL COMPANY, WYOMING, PA.

In addition to the various commercial exhibits on the main floor were others by state and municipal highway departments. Among the states represented were Massachusetts, New Jersey, Maine, New Hampshire and Florida. New York City and Boston both had displays. The U. S. Office of Public Roads showed models of all standard types of construction, while the Massachusetts Institute of Technology featured its courses in highway engineering and research, one set of blueprints giving the results of tests of tractive resistance of vehicles on paving surfaces of different types.

Unusual durability for its product is claimed by the Wyoming Shovel Works of Wyoming, Pa., which had on display its chrome-nickel, heat-treated blades.

Heavy Motor Equipment

An indication of the extent to which motor-driven apparatus is used by the contractor of to-day in road-building was reflected by the exhibit of heavy equipment in the basement of Mechanics Hall. The International Motor Company showed a 5½-ton, 4-yd., back-dumping Mack truck. By means of inclined mirrors and electric lights, the gear-shifting scheme was plainly indicated. The Garford Motor Truck Company of Lima, Ohio, showed its huge new "road-builder" truck with 5-yd. back-dumping body. This machine runs on steel tires 20 in. wide for the rear wheel and 10 in. wide for the front wheel. A new feature is claimed to be the worm-drive jack shaft. Other large-sized back-dumping motor trucks for road work were displayed by the Packard Motor Car Company of Boston, the General Motors Company of Pontiac, Mich., the Sterling Motor Truck Company of Milwaukee, the Kinney Manufacturing Company of Boston, with a back-dump Kelly-Springfield dump, the Signal Motor Truck Company of New England, the White Company of Cleveland, and the Locomobile Company of America.

Light Trucks

A number of types of light trucks also were on exhibition. The Smith Form-A-Truck was shown in several styles, embodying the adaptation of a Ford car to the haulage materials. The Auto-Car Company, of Ardmore, Pa., also showed a light truck. The Duplex Truck Company, of Lansing, Mich., featured a Troy 5-ton, steel-body trailer.

While the transportation end of road construction was the largest feature of the downstairs exhibit there was a big display of construction and maintenance plant. Charles Hvass & Company, Inc., of New York, had a motor-driven sweeper and a large pressure distributor for bituminous materials. Plows and tractors, using kerosene fuel, were featured by the International Harvester Company, while a Socony distributor for penetration road work was an instructive feature of the display of the Standard Oil Company, of New York.

A wide variety of equipment was on hand at the booth of Dyar Supply Company, of Cambridge, Mass. There were a portable stone and gravel heater, an air compressor mounted on wheels, a Haiss digging wagon loader and a leaning wheel grader. Another elaborate display was that of the Kinney Manufacturing Company, of Boston, which, in addition to its large truck previously noted, showed a Jones road planer invented by the superintendent of streets of Waltham, Mass. This machine is a heavy cast iron frame with vertical teeth and adjustable blades for maintaining bituminous surfaces. There was also a huge distributor and oiler mounted on a motor truck chassis, the oiler being detachable in favor of a dumping body.

A portable rock drilling outfit was featured by Chris. D. Schramm & Sons, of Philadelphia; there was a No. 2 outfit for holes 6 ft. or less in depth and a No. 3 for holes up to 12 ft. A portable rock crusher was shown by the New England Road Machinery Company, while the New England Truck Company, of Fitchburg, Mass., had on display a large distributor for heated oil.

Concrete Mixers

Concrete road construction had several representatives among the exhibitors. The Koehring Machine Company, of Milwaukee, showed its huge pavers, embodying a concrete mixer and a boom and bucket distributing system. The Jaeger Machinery Company, of Columbus, Ohio, had on exhibition its new 6-ft. mixer on which the clearance has been reduced from the old value of 9 ft. 2 in. to 6 ft. 2 in. by altering the loading device. This machine, it is claimed, is particularly adapted, in addition to its regular uses as a concrete mixer, to forming a grout for brick or granite block pavement and also for mixing cold road oil emulsions. A huge 16-ton road roller with scarifying attachment was the feature of the Buffalo Steam Roller Company's display. Two types of concrete mixers were shown by the Lansing Company, of Lansing, Mich.

Open Columbia River Bridge

The interstate bridge across the Columbia River, connecting Vancouver, Wash., and Portland, Ore., was thrown open to traffic this week. The steel structure is 23,000 ft. long, including the approaches, and contains ten truss spans each 265 ft. 6 in. long, three truss spans each 275 ft. long and one girder span of 50 ft. One of the 275-ft. spans is a drawspan of the vertical-lift type, which can be raised to give 150 ft. clearance above high water. The cost of the bridge was \$1,750,000.

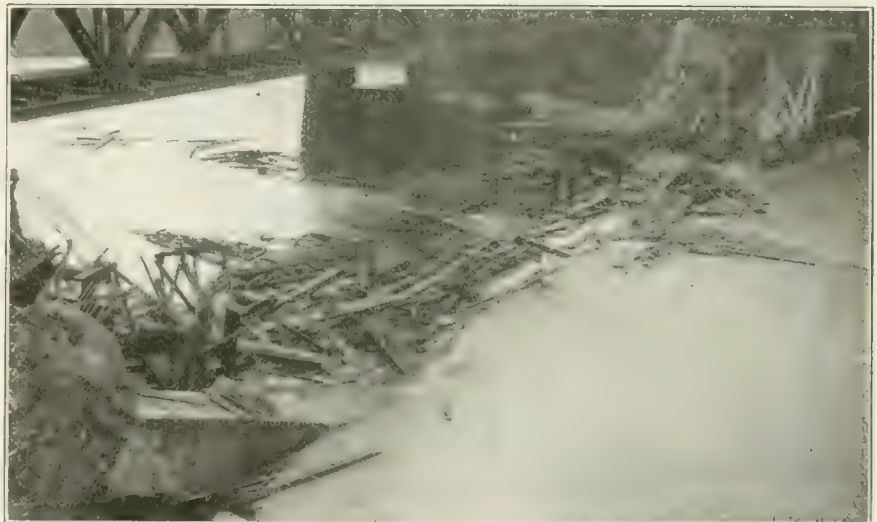
New Jersey Proposes Road Bill

Unless counties in New Jersey in their road building operations meet the standards of patrol systems and maintenance set for them in the proposed road bill to be presented to the Legislature they will be deprived of financial assistance from the State for their highways in case the bill is passed. At present the motor-vehicle fund of \$1,200,000 is used exclusively for maintenance of highways, and the State annually appropriates \$500,000 for new thoroughfares. This money, in the future, will be at the disposal of the proposed commission. No State aid will be given the counties unless they comply with all the requirements of the department for patrol systems and maintenance.

Falsework Failure Drops 250-Foot Arch Ribs Into River

Post Street Bridge in Spokane, Wash., Collapses During Construction and Three Men Lose Their Lives

As noted briefly on page 242 of last week's issue, the falsework supporting the reinforced-concrete arch ribs of the 250-ft. span for the new Post Street Bridge in Spokane, Wash., collapsed suddenly on Feb. 6. Three men lost their lives and eleven were badly injured. According to the evidence reported to the city engineer, Morton Macartney, and furnished to the Engineering Record on request by S. Clark



ARCH RIBS OF 250-FOOT SPAN DROPPED BY COLLAPSE OF FALSEWORK

Patchin, the falsework fell straight into the river, as seen in one of the photographs, and the steel reinforcement was either pulled clean and bent down where the ribs broke or was broken in some cases.

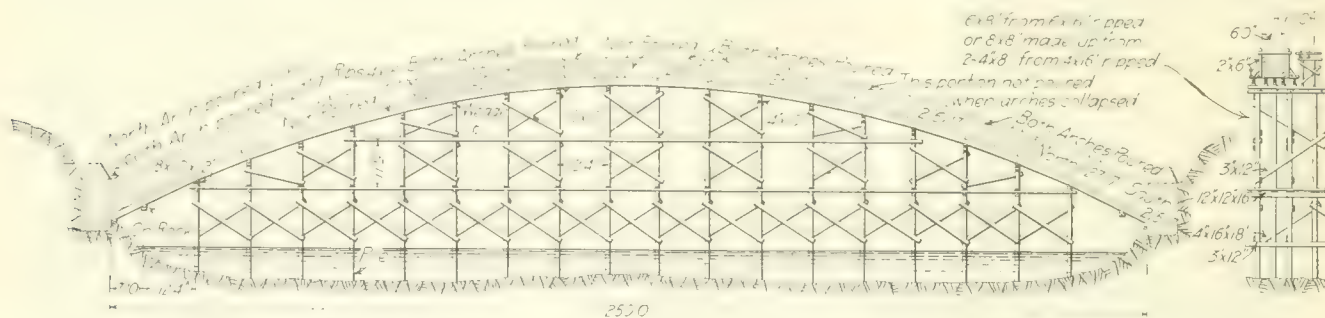
According to the available information, no cause for the collapse can be given. Foreman H. O. McCall, superintendent on the work at the time and successor to P. F. Kennedy, who lost his life by falling from the bridge on Jan. 31, stated that the work had been proceeding smoothly according to the plans of Mr. Kennedy. Details of the falsework are shown on the drawing, the dates and location of the concrete

What Engineers and Contractors Are Doing

E. J. MEHREN, editor of the Engineering Record, has been elected first vice-president of the McGraw Publishing Company Inc., succeeding Hugh M. Wilson, resigned. He will continue as editor of the Engineering Record, devoting to each position half of his time.

J. G. WHITE & COMPANY, INC., announce the election of vice-presidents of the company as follows: Russell B. Marchant, formerly treasurer of J. G.

tions. Since September, 1907, Mr. Goss has held the position of dean, as well as that of director, School of Railway Engineering and Administration and also professor of railway engineering. Graduated from Massachusetts Institute of Technology in 1879, Mr. Goss received the degree of Master of Science from Wabash in 1888 and Doctor of Engineering from the University of Illinois in 1904. In 1879 he organized the department of practical mechanics, Purdue University, where he later, 1890, became dean of the engineering school. He held this position until his appointment in 1907 to the University of Illinois. He held im-



DETAILS OF FALSEWORK THAT FAILED DURING CONSTRUCTION OF ARCH RIBS—DATES OF POURING SECTIONS INDICATED

sections placed up to the time of the collapse being indicated. The arch is 50 ft. high, and it was expected to pour the final sections on Feb. 7. The total weight of the collapsed rib is estimated at about 1500 tons.

The contractors, Olson & Johnson, of Missoula, Mont., requested that the time for completion be extended to Nov. 15, but the city commissioners agreed that the \$10 per day penalty would not be charged if the contractors went right ahead with the work. The contract price was \$32,880, and the loss is estimated at about \$10,000.

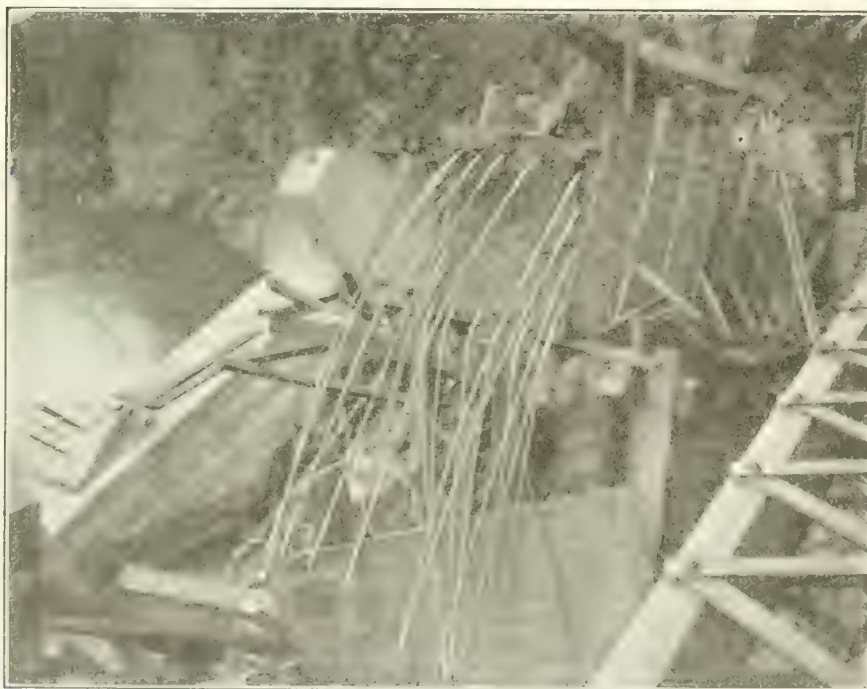
White & Co.; Douglas I. McKay, formerly assistant to the president of J. G. White & Co.; Sanger B. Steel, formerly manager of Paine, Webber & Co., Chicago.

W. F. M. GOSS, dean of the college of engineering, University of Illinois, has resigned, effective March 1, to accept the presidency of the Railway Car Manufacturers' Association of New York. The aim of the association, which is barely a year old, is to represent the car building industry, to promote efficiency and to work for the standardization of parts and specifica-

portant posts in both the Chicago Exposition in 1893 and the St. Louis Exposition in 1904. He was chief engineer of the commission of investigation on smoke abatement and electrification of railway terminals, Chicago, 1913-15. Among the books of which he is the author are: Locomotive Sparks, Locomotive Performance, Superheated Steam in Locomotive Service, besides other books and many scientific reports and papers. No successor will be appointed to Dean Goss until the university board meets early in March.

C. F. HEALEY has resigned as special investigating engineer in the engineering department of the city of Chicago and has accepted the position of consulting engineer of the United Engineering Company, general contractors, Chicago. Mr. Healey was formerly district engineer on the construction of the Chicago, Milwaukee & St. Paul Railway (Puget Sound extension) and located some of the difficult portions of that line, notably the sections through the Hell Gate and Silver Bow canyons, Montana, and the western side of Snoqualmie Pass in the Cascades. Subsequently he was associated with Fuller & Manley, consulting engineers, Tacoma, Wash., and for a time was a member of the firm of Creelman, Putnam & Healey, engineers and contractors, Tacoma. Latterly he has devoted himself to increasing the efficiency of organizations and equipment, and this has been his special work with the engineering department of the city of Chicago.

EDWARD W. DAHL has been appointed city engineer of Yuma, Ariz., succeeding W. H. Elliott, resigned. Mr. Dahl was formerly engineer for Yuma County.



BROKEN MAIN RIB WITH REINFORCING STEEL BENT DOWN AND STRIPPED CLEAN

Virtual Blockade May Increase Car Shortage

Situation Better for Lumber Mills, While Orders Are Far Heavier Than Last Fall—Balance of Steel Orders Declines

THE LARGE NUMBER of American and other neutral cargo vessels tied up in our ports because of the fact that this government has not yet announced any definite policy for their protection against German submarine raids, may cause further railroad traffic congestion and delay improvement in the car situation, unless action is taken shortly which will result in these vessels clearing for their destinations. It is pointed out in this connection that, purely as a result of inability to move the goods if the present situation continues, price levels of materials which have figured heavily in our exports, of late, may be lowered, while prices of materials which we import may rise. The opinion continues to be expressed by some well-informed economists that Germany is nearer exhaustion than is generally believed, and on that account is attempting to draw the United States into the struggle for her own advantage, knowing that it cannot be prolonged. The same men, however, hold that even should 1917 see peace declared, unusual activity in general business, and especially in construction work, should prevail at least during the first half of the year.

As foreshadowed by information reaching this journal last fall, lumber orders have increased greatly during the past few weeks, especially at mills producing yellow pine. Orders received at about 150 of these mills have been considerably in excess of normal for the fourth consecutive week, and while shipments have approached normal during the same period, there is still an extraordinary balance of unfilled orders on hand. With Western mills sawing fir, orders received during the same period, while not up to normal, have shown very considerable improvement. On the other hand, the car situation is still acute in this territory, and cold weather is making production expensive.

For the first time in recent months the unfilled tonnage of the U. S. Steel Corporation shows a decrease, being slightly below the new record established on the first of the year.

Buildings

Building construction noted in this issue includes the following:

Contract awarded:	Kind	Cost
Toronto, Ont.....	Military plant	\$3,000,000
Bids desired:		
Omaha, Neb	Hotel	100,000

Proposed work		
Tramway, N. J.....	Richard	300,000
Philadelphia, Pa.....	Al. Throat	100,000
August, G.....	Hobbs	100,000
Iowa City, Ia.....	University buildings	300,000
Spokane, Wash.....	Electric	100,000
Martinez, Cal.....	Refinery	500,000

Roads and Paving

Highway projects noted in this issue include the following:

Contracts awarded:	Kind	Cost
Wilson, N. C.....	Asphalt	\$200,000
DeQueen, Ark.....	Macadam	140,000
Bids desired:		
East Rochester, N. Y.....	Paving	100,000
St. Louis, Mo.....	Paving	110,000
Proposed work:		
Somerville, Mass.....	Highway	450,000
Mayo, Fla.....	Highway	250,000
Zanesville, Ohio.....	Highway	300,000
Cincinnati, Ohio.....	Road work	600,000
Champaign, Ill.....	Road work	1,653,000
Pontiac, Mich.....	Brick	192,000
Sacramento, Cal.....	Concrete	1,750,000

Waterworks and Sewers

The larger projects noted in this issue are summarized in the table below:

Bids opened:	Kind	Cost
Hamilton Township, Pa.....	Sewers	\$247,000
St. Paul, Minn.....	Reservoir	251,000
Bids desired:		
Niagara Falls, N. Y.....	Sewers	150,000
Proposed work:		
Chicopee, Mass.....	Waterworks.....	200,000
Stratford, Conn.....	Sewers	300,000
Sidney, N. Y.....	Waterworks	160,000
Syracuse, N. Y.....	Sewer	200,000
Rochester, N. Y.....	Disposal plant and water-works	175,000
York, Ont.....	Waterworks	246,000

Miscellaneous Headings

The lowest bid received at Philadelphia for constructing three sections of the delivery loop of the new subway was \$5,784,000. Bids will be opened March 15, at Fort Laramie, for reclamation work involving more than two and a quarter million yards of excavation. A contract will be let March 2 at Seattle for constructing a \$200,000 bridge substructure. Bids for the \$900,000 tunnel to be built at Los Angeles will be opened Feb. 26.

It is reported that work will start soon on the construction of a \$1,000,000 railway line near Charleston, W. Va., and a company has been organized to construct 60 miles of railroad near Pearson, La. A hydroelectric development and railroad proposed at Edith, Mo., will cost \$4,000,000. Plans have been prepared for improving at a cost of \$300,000 a bridge at Little Rock, Ark. It is reported from Bozeman, Mont., that \$2,000,000 will be expended on a 33-mile railroad cutoff.

WATERWORKS AND SEWERAGE SYSTEMS

PROPOSED WORK

Chicopee, Mass.—Frank P. Cobb, city engr., estimates cost of standpipe and new water mains contemplated by City Council at \$200,000; plans also being prepared for sewer for district bordering upper Chicopee St.

Chicopee, Mass.—Water Dept. plans erecting 2 new stand pipes and installing water mains to cost \$200,000. F. P. Cobb, city engr.

Sherborn, Mass.—Election to be held in March on question of issuing \$35,000 bonds to be used for laying 5 miles of 6 and 8-in. c. l. pipe, 37 manholes, valves, etc.

Central Falls, R. I.—S. P. Cumings, city engr., completed plans for sewer to be constructed in Hunt St., from Illinois to Dexter St., during coming season.

Stratford, Conn.—Bill introduced in House to permit town to issue \$300,000 bonds for construction of sewers for Hollister Heights and outlying districts.

Dansville, N. Y.—Election will soon be held in village to vote on issuing \$12,000 bonds for water supply extensions.

Gloversville, N. Y.—Plans being prepared for 100,000,000-gal. storage reservoir; cost about \$40,000.

Lynbrook, N. Y.—Construction of waterworks, sewer system and sewage disposal plant being considered. Frank H. Johnson, village clk.

Rochester, N. Y.—Bonds for \$100,000 sold for sewage disposal plant and \$75,000 for waterworks improvement.

Sidney, N. Y.—Village has voted \$165,000 bonds to be used for waterworks.

Syracuse, N. Y.—City Engr. H. A. Allen estimates cost of constructing eastern section of 17th Ward sewer at \$205,000; it will be about 14 miles long and includes straightening of channel of Meadow Brook and lining it with concrete and 1400 ft. of tunnel where the sewer will pass through a hill; invert or floor of tunnel will be concrete and roof of rock. Contractors will be given the option of making an open trench instead of the tunnel.

Mendham, N. J.—Boro. considering construction of 7,000,000-gal. reservoir; also laying 14,000 ft. 8-in. pipe line extensions. Leo Tobinson, boro. clk.

Ocean City, N. J.—Special election Feb. 27 to vote on question of issuing \$14,000 bonds for new surface water drain on 12th St.

Dallastown, Pa.—Boro. Council will probably soon call election to vote on question of constructing waterworks.

Erle, Pa.—Gannett, Seelye & Fleming, Harrisburg, are consulting engrs. for sewage disposal plant and intercepting sewers to be constructed here.

Monaca, Pa.—City Council considering extensive improvements to sewers, also increase of water supply, including new pump and 1,000,000-gal. reservoir. Michael Baker, boro. engr.

Sayre, Pa.—Plans being prepared for sewer system and sewage disposal plant; cost about \$40,000. R. R. Fernow, engr., Weightman Bldg., Philadelphia.

West Chester, Pa.—Plans being prepared by N. R. Rambo, boro. engr., for a sanitary sewer pumping station to be erected early in spring.

Williamsport, Pa.—City Council reported considering construction of municipal waterworks or the purchase of property of Williamsport Water Co.

Petersburg, Va.—John E. Harvell, chmn. sewer and water comm., estimates cost at \$51,097 for construction of city water mains and sewers.

Fairmont, W. Va.—Plans being prepared for sanitary sewer system and sewage disposal plant; cost about \$30,000. S. B. Miller, engr.; Albert J. Kern, city clk.

Chesterfield, S. C.—McCrary Eng'g Co., Atlanta, Ga., reported preparing plans for waterworks and sewer system. Town council has petitioned state legislature for permission to issue bonds for construction.

Fountain Inn, S. C.—Town will petition State Board for permission to issue \$100,000 bonds for waterworks and sewers.

Tennille, Ga.—City considering construction of waterworks, cost, about \$25,000.

Monroe, La.—City Council considering calling an election to vote bonds for drainage, sewer system, waterworks, street improvements.

Cleveland, Miss.—City has engaged Kearney-Speed Eng. Co., 1212 Exchange Bldg., Memphis, Tenn., to prepare plans for sewer system.

Nashville, Tenn.—According to estimates of City Engr. W. W. Southgate, submitted to the Bd. of City Comrs. and Commercial Club committee on sewers at a recent conference at mayor's office it would cost \$1,351,937 to furnish sewerage facilities to sections of the city where there are now no sewers.

Springfield, Tenn.—Water bonds for \$36,000 will be sold Feb. 20 by Chas. E. Rich, mayor.

Auburn, Ky.—City considering construction of waterworks. H. B. McClary, city clk.

Clifton, Ky.—Geo. Lindsay, city engr., preparing plans for trunk sewer system for district which will extend through the mill bottoms to the Ohio River; cost about \$200,000.

Belleville, O.—City has engaged W. J. Sherman Co., 613 The Nasby, Toledo, to prepare plans for an improved water supply.

Dayton, O.—City Waterworks Dept. planning construction of several large reservoirs in various sections of city to aid in distribution of water supply. Leonard Metcalf, engr., 14 Beacon St., Boston, Mass.

Lakewood, O.—City considering construction of sewage treatment plant; cost, about \$40,000. E. A. Fisher, city engr.

Lima, O.—Water bonds for \$30,000 will be sold Feb. 26 by D. L. Ruppert, city aud.

Salem, O.—W. J. Sherman Co., 613 The Nasby, Toledo, has been engaged by city to prepare plans and estimates for reconstruction of sewage disposal plant.

Sebring, O.—A filtration plant may be constructed by Mellon Co., of Pittsburgh, owners of the Sebring Water Co.

Wauseon, O.—Village has engaged W. J. Sherman Co., 613 The Nasby, Toledo, to prepare preliminary plans and estimates for an improved water supply.

Alma, Mich.—City considering construction of new pumping station, standpipe, wells, pump and all necessary equipment. Carl E. Gallagher, city clk.

Lowell, Mich.—City considering construction waterworks; cost, about \$60,000.

North Branch, Mich.—Contract will soon be let for about 3000 ft. of 8-in. sewer with 9 manholes. F. A. Sickstedt, village engr.

Alton, Ill.—City considering construction of trunk sewer to cost \$100,000. Edmond Reall, mayor.

Farmington, Ill.—Geo. F. Hubbard, city clk., writes H. W. Clark Co., of Mattoon, are preparing plans, specifications and estimated cost of waterworks improvements, consisting of deep well, reservoir, tower and laying mains, etc. Election will probably be held in April to issue bonds.

Findlay, Ill.—Village considering construction of sewer system; cost about \$30,000. R. A. Miller, engr., Decatur.

Quincy, Ill.—Public meetings approve sewer improvements in Maine, Hampshire, 24th, 25th, Oak, Maple and other streets; cost about \$11,658.

Warsaw, Ill.—City considering construction of waterworks. Wm. L. Hill, mayor.

Wenona, Ill.—Election will be held this spring to vote \$14,000 bonds to extend water system, including new well and repair of pipes. Hall, Moose and Martin, Bloomington, attys.

Madison, Wis.—Plans being prepared by Gordon, Balch & Lippert, archts., Wisconsin Bldg., for remodeling waterworks; cost about \$240,000.

Audubon, Ia.—Reported that 1000 ft. of water mains and an elevated tower being considered. A. Segel, city engr.

Denison, Ia.—City considering sewer improvements during year. Frank Woolston, city engr.

Messena, Ia.—C. McBride, city clk., writes 21 blocks of water mains will be laid and 50,000-gal. tank, 78 ft. high, will be installed; cost about \$17,000.

St. Paul, Minn.—City Council has approved plans for construction of sewers on Strong, Marshall and Taylor Sts.

Lexington, Capital, Snelling, White Bear, Pascal, Doswell and Asbury Aves.

Ellsworth, Kan.—City considering construction of storm sewer; cost, about \$70,000. Black & Veatch, engrs., 507 Interstate Bldg., Kansas City, Mo.

Kansas City, Kan.—Survey being made in Argentine for a site to be used for a 10,000,000-gal. concrete reservoir to supply Kansas City and Rosedale. Louis M. Chapman, water & light comr.

Nashville, Ark.—Bonds for \$100,000 sold by city to be used for waterworks and sewer system; plans prepared by Winters & Dove, Ft. Smith; sewer system will consist of 8-mile line and laterals, from 8 to 15-in.; water system, 10 miles of line, 2 to 8-in. water mains, hydrants, gate valves, wells, concrete reservoir, capacity 150,000 gals., elevated steel tank, etc.

Athens, Tex.—Bonds for \$32,000 sold by city to be used for waterworks improvements and constructing sewer system at an early date.

Beeville, Tex.—City planning construction of waterworks. John S. Fenner, city engr.

Big Springs, Tex.—Henry E. Elrod, Interurban Bldg., Dallas, has been engaged to prepare plans for sewer system and waterworks.

El Paso, Tex.—See "Excavation Drainage & Dredging."

La Grange, Tex.—Contract soon to be let for constructing sewage disposal plant. Ed. Mattingly, city secy.

Marlin, Tex.—City has selected site for construction of sewage disposal plant, survey now being made. Construction will be started in about 30 days.

Midland, Tex.—Henry E. Elrod, Interurban Bldg., Dallas, has been engaged by city to prepare plans for sewer system and waterworks.

Waco, Tex.—See "Miscellaneous."

Waxahachie, Tex.—Atty. General's Dept., Austin, has approved following bond issues: \$20,000, sewers; \$10,000, streets; \$90,000, schools.

Commerce, Okla.—Town considering question of constructing sewer system.

Okemah, Okla.—Election soon to be called to vote on question of issuing \$50,000 bonds for constructing sewer system. Benham Eng. Co., Oklahoma, to prepare plans and specifications and supervise construction.

Camas, Wash.—Council accepted plans and contracts will soon be let for materials and installation of municipal waterworks. Plans provide for 3 types of reservoir, which will be concrete, capacity 700,000 gal.; work includes headworks, pipe line 7 miles long and rearrangement of existing distribution system, which will be taken over from private interests; cost between \$75,000 and \$100,000. L. B. Wickersham, cons. engr., Chamber of Commerce Bldg., Portland, Ore.

Camas, Wash.—L. B. Wickersham, engr., Chamber of Commerce Bldg., Portland, Ore., completed plans and estimates for construction of municipal waterworks; cost, between \$80,000 and \$100,000; work includes pipe line, reservoir and local distributing system.

San Francisco, Cal.—In the annual report of M. M. O'Shaughnessy, city engr., the sum of \$11,000,000 is requested to continue work on the Hetch-Hetchy water supply project, including \$6,000,000 for aqueduct, \$4,000,000 for a dam.

Ventura, Cal.—Plans being prepared by City Engineer for sewerage system; cost about \$10,000. City Trustees considering election to vote bonds for constructing this improvement; also for storm sewer and culverts; cost about \$30,640.

Yuma, Ariz.—F. E. Trask, engr., Union Bank Bldg., Los Angeles, Cal., engaged by city to make estimates of cost of constructing municipal waterworks and light plant.

Montreal, Que.—City Council reported to have decided to construct sewer in St. Patrick St., to cost \$35,000.

Nonlinque, Que.—Roy & Toupin, engrs., 72 Notre Dame St., E. Montreal, are preparing plans for aqueduct to cost \$25,000. Work to start in spring.

Hamilton, Ont.—See "Roads and Paving."

York, Ont.—Contract will soon be let for constructing waterworks; cost, about \$245,830. F. Barber, engr., 57 Adelaide St., E. Toronto.

Edmonton, Alta.—City considering installation of chlorine sterilization plant at waterworks to treat 6,000,000 gal. of water. A. G. Harrison, city comr.

BIDS DESIRED

Boston, Mass.—Until Feb. 20, by Edward F. Murphy, comr. pub. wks., for furnishing 150 Boston post hydrants, 375 Boston valves of from 6 to 12 in.

New York, N. Y.—Until Mar. 6, by Bd. Water Supply, Municipal Bldg., (George Featherstone, secy.) for Cont. AH for furnishing and delivering liquid chlorine for use at Kensico Screen chamber of Catskill Aqueduct.

Until Feb. 26, by William Williams, comr. water supply, gas and electricity, for furnishing, delivering and unloading, stacking and storing c. i. pipe and valve boxes, castings for Brooklyn and Richmond Boros.; security \$5,000.

Niagara Falls, N. Y.—Until Feb. 24 by O. E. Carr, city mgr., for constructing sewers and appurtenances; work includes about 6760 lin. ft. of from 42 to 72-in. pipes; advertised in this issue.

Ogdensburg, N. J.—Until Mar. 15, by L. A. Sweeney, for constructing waterworks and 300,000-gal. capacity reservoir; Wm. N. Harris, boro. clk.; Jas. B. Rider, 29 Eway, N. Y., engr.

McKeesport, Pa.—Until March 12 by City Council (C. E. Soles, controller) for about 24,000 lin. ft. of from 8-in. to 24-in. vitr. tile sanitary sewers and necessary 5-in. "Y" branches and manholes; advertised in this issue.

Washington, D. C.—By Samuel McGowan, paymaster gen. of navy, Bureau Supplies and Accounts, Navy Dept., for Sch. 745, Valjejo, steel pipe; Sch. 729, Philadelphia, seamless steel tubing; Sch. 740, Brooklyn, N. Y., water heater valves; Sch. 733, Charleston, S. C., two centrifugal flushing pumps.

Clarksdale, Miss.—Until Feb. 27 by City Comrs. (W. W. Pointer, supt. water and light dept.) for sale of used equipment; advertised in this issue.

Cleveland, O.—Until Feb. 21, by Comr. Purchase and Supplies, 319 City Hall, for constructing sewers in Coit Road, E. 30th, E. 103rd, E. 113th and other streets.

Portage, Wis.—Reported desired until Mar. 1 for constructing filter plant; cost \$30,000. Address L. P. Wolff, Germania Bldg., engr.

Denver, Ia.—Until Feb. 24, by F. T. Farnsworth, town clk., for constructing sanitary sewer system and disposal plant; work includes 16,000 ft. of 6 to 12 in. pipe; G. H. Bishop, city engr., Oelwin.

Larned, Kan.—Until Feb. 26, by L. D. Bingers, city clk., for constructing sewer and sewer pumping plant; cost about \$27,500.

Castlewood, S. D.—Until March 7, by Castlewood Waterworks system, bonds for about \$20,000 will be issued for this work: Freed & Sours, Inc., contr. engrs., Watertown; two separate contracts to be let, one including pumping equipment.

Beaumont, Tex.—Until Feb. 20 by J. G. Sutton, city secy., for laying 28,000 ft. of from 6 to 8-in. water pipes, including all necessary lead and caulking jute and placing of seven 6-in. valves, etc.; advertised in this issue.

Stroud, Okla.—Until Feb. 23, by town for furnishing material and equipment for waterworks and electric light; Benham Engr. Co., const. engrs., Oklahoma City.

Anaheim, Cal.—Reported desired until Feb. 23, by Edward B. Merritt, city clk., for constructing, on concrete foundation, motor driven pumping plant with a capacity of 1500 gal. per min. at a pressure of 125 lb. per sq. in.

Tecumseh, Ont.—Reported desired until March 1, by R. W. Code, Bd. Trade Bldg., Windsor, engr., for 2 centrifugal pumps and motors installed complete (hor. split casing type) of 250 gal. per minute capacity for Eau Claire Waterworks Co., Ltd.; cost about \$20,000.

PRICES AND LETTINGS

★Indicates award of contract

Hamilton Township, Pa.—Following are lowest bids opened Feb. 1 for following 3 sections of sewers: Breslau, 1st section; Lee Park, 2d section; Newtown, 3d section of Hamilton Township, to be about 14 miles in length: Martin & Miller, Caldwell, N. J., bid lowest at \$246,799 for all 3 sections; Jos. Banks Constr. Co., Wilkes-Barre, in 1st section bid lowest at \$101,220, and low for tile on second section, \$76,589 (probably awarded contract); in 2d section the low bid was B. G. Coon Constr. Co., on concrete pipe sewer at \$75,438; 3d section, M. J. Malloy of Sugar Notch lowest at \$60,482.

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Commissions in Officers' Reserve Corps

THE INTEREST of engineers in the movement for military preparedness is reflected in Army orders published last week listing appointments to commissions in the Officers' Reserve Corps. Among the names are those of a number of well-known engineers. Bion J. Arnold, consulting engineer, of Chicago, and John J. Carty, past president of the American Institute of Electrical Engineers, have been named majors. Others appointed to this rank are John H. Finney of Washington, E. W. Stern of New York and F. A. Molitor, secretary of the American Institute of Consulting Engineers. From the Middle West, Frank G. Jonah of St. Louis, a director of the American Society of Civil Engineers, and Prof. Gardner S. Williams of Michigan University, have been appointed majors. The list of captains, first lieutenants and second lieutenants is a long one, and includes men identified with important engineering work of all kinds throughout the country. It is to be noted that, on a geographical basis, the East shows overwhelming preponderance of appointments as compared with territory covered by the central and western departments of the Army. However, the work is still in its early stages. A great many more reserve officers will be needed, and it behooves those who are willing to volunteer their services to apply now to be examined. It is understood that the War Department's requirements, while high, are not so strict as to exclude a man not letter perfect in military detail.

A Unique Construction Problem

THE inclined tunnels driven to insure the stability of the Michigan Northern Power Company's plant at Sault Ste. Marie, described on page 292 of this issue, represent a most ingenious solution to a problem unique in hydroelectric construction. Since this power plant was designed and built the tendency in hydroelectric design has been away from a large number of small units to generate power under low heads. The problem of the company which took over this development was to procure the maximum efficiency from the plant, which was more than 1500 ft. long and contained 81 tail pits for independent generator units. The thrust developed under the heads at which operation was most economical produced a slight displacement of the structure itself and made it inadvisable to maintain the forebay at the operating level contemplated in the original design. To jack inclined pipe piles down to rock beneath—the piles to take up this thrust—was impracticable because of the large number of vertical piles already driven to support

the plant. Some of the best engineering talent of the country has been engaged on the solution of this problem, and as a final result the extraordinary method of driving inclined tunnels with compressed air has been resorted to. The construction work itself has been successful in every particular, and there is no reason to doubt that when completed it will fulfill its mission. The ingenuity with which the construction difficulties were overcome furnishes an interesting insight into the resourcefulness of the modern construction engineer. The work proves again, if proof were needed, that where there is adequate reason for putting forth the effort the American contractor can be counted on to stop at nothing short of the accomplishment of the results desired.

For Better Operation

PROBABLY no other structure which the municipal engineer builds needs more attention—and gets less—than the sewage-disposal plant. Several years ago Prof. C. E. A. Winslow made a trip in the winter to the Middle West to learn how various plants were being operated. To his astonishment he did not find a single one working. Apparently progress is not fast, for a record not much better was reported for eight plants in Illinois visited in January by a representative of the newly established engineering department of the State Board of Health, as noted on page 307. It is true the towns are not large and practically none has organized sewer departments, but at some time in the past there has been sufficient interest or pressure to furnish funds for construction. Undoubtedly in each case an engineer has been employed to design the treatment works. While he may have felt that he did his full duty at the time of the completion of the work in giving instructions as to operation, maintenance and appropriations for them, he has not done enough, if we are to judge by results. The argument that he is not now responsible will not answer. He, or at least the profession, must carry a share of the blame if the plant does not produce the results for which it was designed. His education of the layman officials and citizens of that particular city was not sufficient to insure proper operation after he left. The desire to keep down expense, however laudable, must be controlled by the exigencies of individual cases. One practical way out of the difficulty would seem to be to retain continually the original designer, or some other qualified engineer, on a small retainer to keep an experienced eye on the operation. Many eastern cities are doing this, but the plan needs indorsement farther west.

Time to Stop "Passing the Buck" on Motor-Truck Legislation

IN ESTABLISHING the new schedule of taxes on motor trucks in New York State, which took effect Feb. 1, the special commission, consisting of the state highway commissioner, the state engineer and the state superintendent of public works, so obviously side-stepped its specific instructions to base the new charges on extent of damage to the roads that its findings did little or nothing to solve a complex problem. It is good news therefore to learn that a bill has been introduced at Albany calling for a new commission to revise the latest commission's revisions. The schedule in its present form is nothing more than a makeshift—and a poor one at that. It was prepared in a hurry, and while the commission was solicitous for the presentation of technical data at its public hearings—and received a great deal of valuable information—it has, in its wisdom, apparently pigeonholed the testimony submitted to it. At any rate, it is hard to discover its influence in the commission's final report. Certainly the schedule of fees, starting with a minimum of \$10 for a 2-ton truck and increasing by \$5 increments per gross ton, is unscientific.

This question of motor-truck legislation in New York State has been a perennial one. In naming its special commission last year, the Legislature, in the light of later developments, is regarded, by the motor truck men at least, as having given an illuminating exhibition of "passing the buck." The latest schedule of fees strengthens the belief that the special motor-truck commission has passed the buck back again. Now as in indoor sport this may all be highly diverting, but the motor truck has reached a position in industrial life which demands for it respectful and intelligent consideration. It is time for New York and other states to get down to the serious business of placing the matter of motor-truck taxes upon a sound, scientific and just basis—and justice must consider the interests of the motor truck as well as those of the highway. Statistics for 1916 show an increase in the use of commercial vehicles in New York State of 66 per cent over the figures for 1915. There were at the beginning of the year 34,653 motor trucks in the state, as against only about 21,000 in the previous year.

The present graduated flat-rate basis of taxation on gross weight alone is entirely illogical, and the new bill to have this schedule revised should be passed. The proposed measure provides for a commission one of whose members shall be an automobile engineer. This is a commendable feature. The tendency in the past has been to make commissions of this sort onesided by having their membership drawn entirely from interests affiliated with the building and maintenance of highways. But there is more than one side to the story, and the motor-truck men as well as the road builders should be heard. Present efforts are being directed to secure a basis of taxation which will grade charges according to loading per inch width of tire, in-

stead of the present gross-weight ruling. The unit-weight plan is already operative in Massachusetts, where the value is fixed at 800 lb. per inch width of tire, and is also contemplated in a new bill before the Michigan legislature.

Former attempts at motor-truck legislation make it seem that those who enact laws fail to appreciate the diversity in motor-truck design. For this reason it is desirable to have an automobile engineer on any commission which attempts to prepare schedules for taxation purposes. In the present New York law the truck running on narrow tires and at high speeds is penalized no more than the vehicle designed to distribute the weight over a considerable area of the road surface by broad tires. Then, too, there are such subjects as springs, overall widths, limitation on gross weight, steel versus rubber tires, and many other factors which should receive consideration. With its public hearings and requests for expert opinion, and then its schedule of fees entirely disregarding scientific principles, the special motor-truck commission achieved a result comparable with that of the mountain which labored and brought forth a mouse.

The new commission, provided for in the pending bill, has an opportunity of performing work of incalculable value if it will conduct its investigation along engineering lines. If its work is well done, it will serve not only New York State but other states throughout the country, which are now, or will soon be, facing the problem of imposing an equitable tax on motor vehicles which use the public highways.

The National Safety Council

ESTABLISHED with the broad purpose of helping to free mankind from accidents, the National Safety Council, numbering among its membership 2500 of the largest industrial, transportation and other corporations in this country, is publishing monthly leaflets on safe practices. Representing, as they do, the findings of a committee of 50 safety experts in the service of this, the leading accident-prevention agency of the country, these leaflets should have a far-reaching effect on the conservation of human life and efficiency. Three of these leaflets—on ladders, stairs and stairways and on boiler rooms—have already been issued. Their purpose is to distribute the information in concrete and popular form throughout the country. No standardizing will be attempted, it being considered that the greatest good can be accomplished by stating the problems met in attempting to reduce accident hazards, together with the best solutions found. The minimum and maximum safety practices are stated, and the requirements of insurance companies, state and local authorities are given when practicable.

While the scope of this work is so broad as to include every phase of accident prevention, it has a direct application to the engineer and contractor. The man who designs and builds structures for the use of others should be familiar with every means which can be taken

to make them safer for those who are to use them. Those who construct public and private works are directly interested in this movement as pointing the way to greater safety and efficiency in their own working force.

Safety work costs less than accidents and increases operating efficiency. The tremendous economic savings which this work can bring about if it is as universally supported as it deserves to be are foreshadowed by the results already accomplished. Of 21 industrial corporations already identified with this movement, reductions in accidents as a result of proper safety work range from 22 to 88 per cent, with a majority of these percentages nearer the higher than the lower figure. Of 15 transportation properties, ranging in size from the Boston Elevated Railway Company to the Union Pacific System, reductions in accidents range from 19 to 80 per cent. The attention of the master minds engaged in increasing the ratio of production to population is undoubtedly turning from material to human factors. Of these, accident prevention is of the most important. The work of the National Safety Council deserves the best of attention and support from the engineering profession.

A New Era in Teaching English to Engineers

SELDOM has the Engineering Record published articles on general subjects that should have as wide a reading as those of Professor Park and Professor Aydelotte on the teaching of English to engineering students. Instruction in English is one of the perennial questions in engineering education. Quite generally the methods now employed are condemned by practising engineers, while, on the other hand, students have even less regard for the courses.

The typical course in English is given in the arts school, by an arts teacher, without any distinction in method of instruction between the arts and the engineering student. The work is intrusted to young members of the faculty, on the theory that it is an abbreviated, incidental course. Engineers do very little work in English, so the theory seems to go; why then dig deeply for them? Is it any wonder that engineering students generally regard the engineering courses as a necessary evil—a means of getting certain credit hours required for graduation?

In the courses at the University of Cincinnati and Massachusetts Institute of Technology, however, the very great importance of English to the engineer is appreciated, and the work is in the hands of those who sympathize with engineers and engineering and are determined to adapt their teaching to the needs of the student. The courses developed are set forth on pages 297 to 302 of this issue.

It will be noted that there is one thing in common in the two plans—the use of theme material that has a bearing on the student's future lifework, and this is

the first of the excellent features of the two systems. The idea, too, is fundamental and the resulting superstructure—the methods of instruction followed—would bring but poor success were general material substituted for engineering material.

But though there is a common idea underlying the courses, their mechanism is decidedly different—and that makes the development all the more interesting and insures a more rapid growth in the teaching of English to engineers than if these two pioneers were working along the same lines. Professor Park aims rather to develop rapidly a good technique in English composition; Professor Aydelotte to make the English courses a means of broadening the engineer's outlook. Both writers reveal in a few flashing sentences the philosophies of their plan.

For example, Professor Park points out that by telling the student to describe a particular engineering process, device or project for a given engineering journal the student's "relation to his subject and audience will be the normal one of the writer who has something interesting to say and who has a definite motive for saying it effectively." And again he says: "There is nothing better for developing mental alertness and skill in writing than the rapid preparation of a variety of articles. It is more than a coincidence that a large proportion of literary men have served some kind of journalistic apprenticeship."

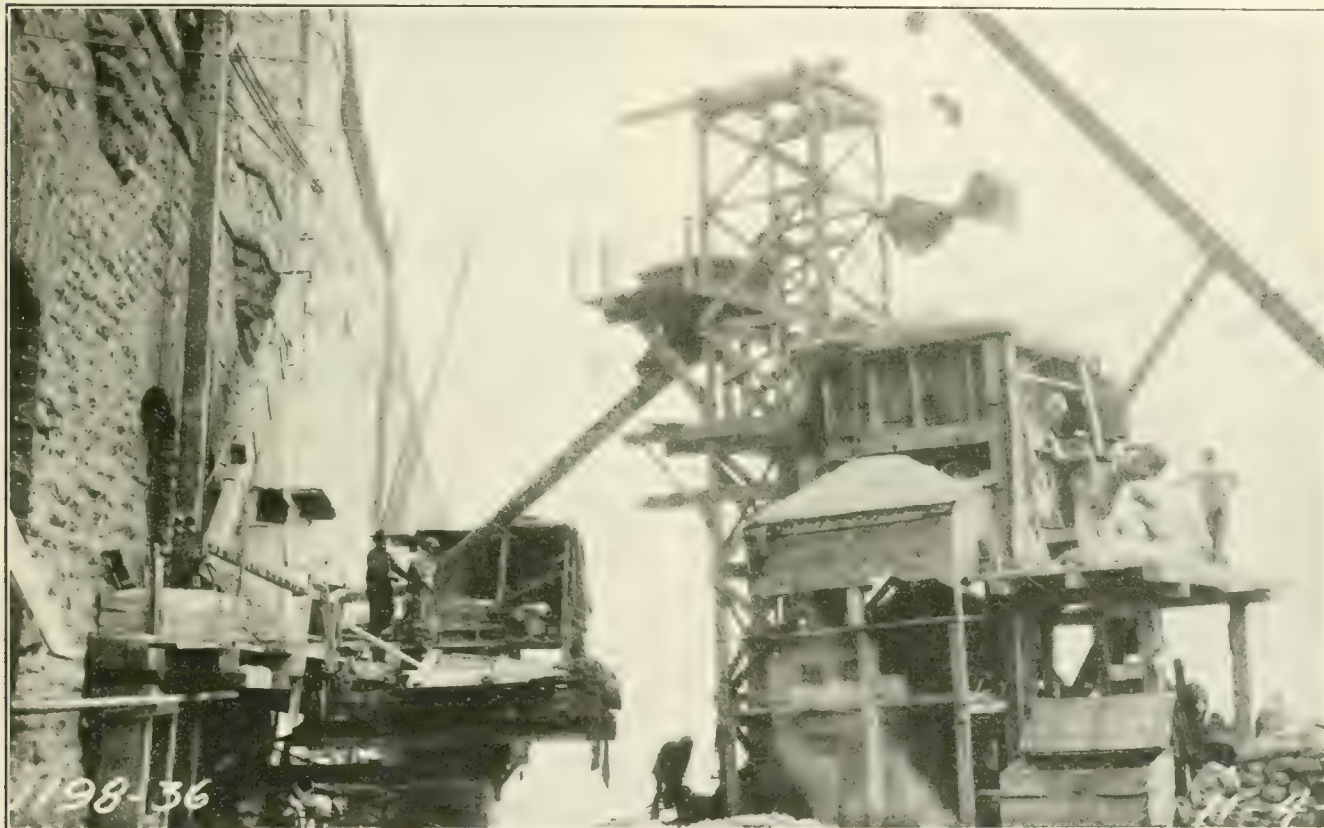
On the other hand, with equal clarity, Professor Aydelotte sets forth the philosophy of the course at the Massachusetts Institute of Technology. Says he: "The widespread demand that our college men, graduates of technical schools and colleges of liberal arts alike should be better able to write and speak their mother tongue is really a demand that they have a better literary education. A man's writing reflects his habit of thought, and it is simply impossible to give him a cultivated style by any other method than by making him a cultivated man."

It will be noted that Professor Aydelotte says nothing about the correction of the themes presented and the conferences regarding defects in logic and rhetoric. Let it be understood, though, that this part of the work is carried out in great detail. In the space available Professor Aydelotte has found it possible to emphasize only the big idea on which the course at Technology is founded.

Naturally the publication of the two articles in one issue prompts comparison. That was not the Engineering Record's object in presenting them together. The thought was rather that, by pointing out at one time the great strides in the teaching of English to engineering students, the engineering profession would better appreciate that a new era in the engineer's education is dawning. Preference will be expressed for the one or the other plan largely in accordance with the experience and the aspiration of the individual. Both plans, however, are excellent, and both are producing most satisfactory results.

on a horizontal plane at the level of the river bed, and formed a hood within which to erect a small tunnel shield. Such a shield, with two rings of segmental cast-iron lining, was assembled in this hood and driven outward and downward on an angle of 40 deg. with the horizontal to rock. After reaching solid rock a chamber was belled out beyond the shield, and the chamber, shield and tunnel filled with concrete. The air-lock and cylinder were then removed for use in another location, and a sectional cofferdam of timber placed around the upper end of the finished shaft and

desired points and dragged on plank through the windows and lowered into the cylinders by the derricks used for sinking. These derricks, of which ten were framed on the job, were supported on engine-bed timbers stuck through windows in the wall on a skew. The end of these timbers supporting the mast was blocked from a narrow ledge outside over one of the dividing walls. The hoists were likewise supported on timbers outside the building, and were supplied by steam lines carried within the power house. In some locations the derrick bed timbers were placed entirely outside the



TUNNELS WERE CONCRETED IN SIX TO EIGHT HOURS EACH BY FLOATING PLANT WHICH WILL ALSO BUILD BRIDGE

the space between it and the end of the dividing wall. Within this space was built an extension to this wall, keyed into its old face, and covering the end of the new shaft. Upon these extended piers, which project 18 ft. beyond the wall of the power house, will be built a reinforced-concrete bridge to form an additional railway crossing over the company's power canal. During this construction about 42 of the tail pits, or all that were equipped for operation, have been in continuous use.

CONSTRUCTION LAYOUT ACCOMMODATED TO EXISTING CONDITIONS

The construction work required means for the receipt, storage and handling of tunnel rings and of cement and concrete materials. A very large compressor plant, with provisions for high-pressure air and hydraulic pressure for operating jacks was necessary, and means had to be found for handling and setting the heavy air locks and cylinders, for hoisting and disposing of excavated material and for mixing and placing concrete.

The cast-iron lining plates were delivered by water, transported on flat cars on a standard-gage track inside the power house next the downstream wall, piled at the

power house parallel to the wall and bracketed out from the wall and the piers. Twenty-five-foot masts handling 25 and 38-ft. booms were used for these derricks. The top of the mast was secured by a single long gooseneck extending through a small window above, a row of which opened on that side of the power house about 25 ft. above the floor. This gooseneck was bolted to a timber spanning the window opening, which in turn was bolted to and braced from the roof framing above. In addition, the gooseneck was blocked from the window opening on all sides. These derricks were inspected daily, and with the first signs of play, cable lashings were added sufficient to make them secure.

FLOATING PLANT HANDLES LOCKS AND CYLINDERS

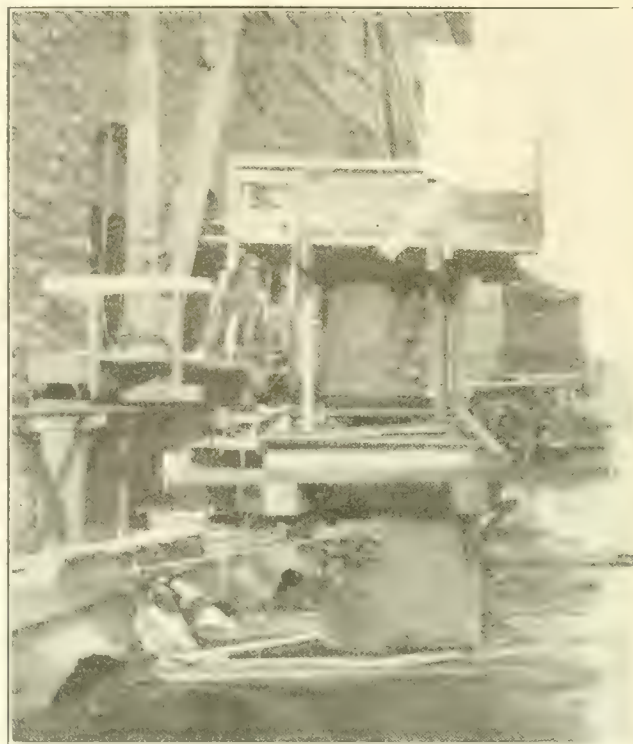
These derricks, however, could not handle the air locks and cylinders, although each of them was able to reach three tunnels from one setup. The heavy pieces were handled by a floating derrick boat built at the site, which was also used as a dredge. The derrick on the mixer boat was also utilized to set locks and cylinders and to assist in dredging. It was equipped with a 1-yd. clamshell bucket, while the other dredge employed a

1-yd. orange peel. The mixer on the floating concrete plant was fed by gravity from overhead bins filled by the derrick, and discharged into a tower skip, which could be raised high enough to spout directly into the air locks. This same plant will also be used to concrete the bridge spans by direct spouting, the tops of the air locks having stood considerably above the deck of the bridge. A tug handled this equipment and towed four scows, the largest of which was used for gravel, the three smaller ones being employed to transport mud used to blanket the tunnels.

CONCRETE MATERIALS HANDLED AT DOCK

All plant and materials were received at a dock just east of the power house. This dock was used as a yard by the contractor, all framing and assembling being done there. During the navigation season, on account of the fact that the company which furnished mixed sand and gravel did not have sufficient scows to permit their use for storage, and of necessity after the close of navigation, a large stock pile of this material was kept on the dock. For heating this material a number of long steam coils were made up on the dock floor, on top of which the sand and gravel was piled by a derrick erected at the spot for unloading purposes. Until the navigation season closed cement was also received by boat as well as coal. A large cement shed was erected capable of holding a shipload. Between the concreting of the tunnels, the mixer boat would be taken down the dock, where it would load its own bins and receive a stock of cement. It held enough material to fill one tunnel, and when more was required the large scow was used to transport it.

High-pressure air for running the drills inside the tunnels was furnished part of the time by a small electrically driven compressor and part of the time by the power company from its regular supply. Compressed air for driving the tunnels was furnished by four straight-line, single-stage compressors installed by the contractor. Two high-pressure pumps driven by steam

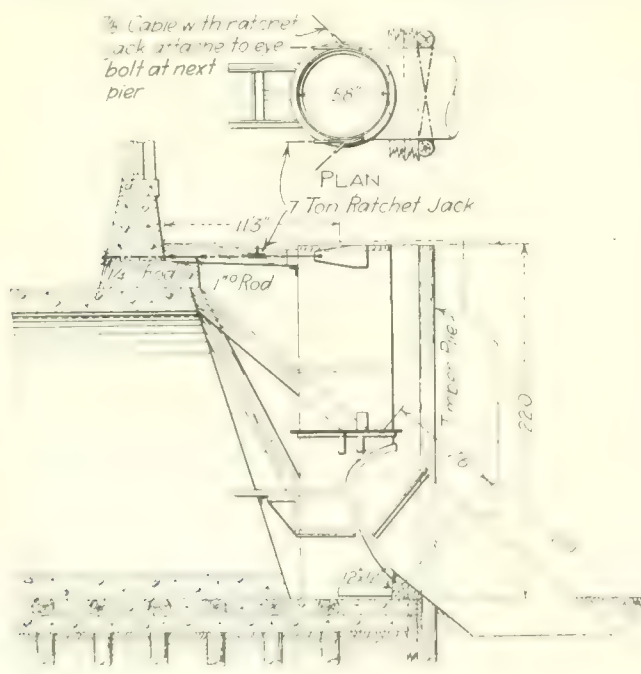


OPERATIONS CARRIED ON IN SCANT WORKING SPACE

and one driven by electricity were installed for operating the hydraulic jacks. For running this equipment two of the boilers in the regular pumping plant of the power company were cut in with three small locomotive boilers installed by the contractor inside the power house and four large locomotive boilers set outside it. All these boilers were connected into one steam main. They also furnished the steam for heating the sand and gravel. The coal consumption of this equipment was large, from 35 to 40 tons a day being used.

CYLINDERS BRACED IN STRONG CURRENT

Equipment was provided for driving ten tunnels simultaneously, and the contractor actually had air on nine of them at one time. In starting work on each tunnel, the first thing done was to inspect the spot on which the cylinder was to be set by diving, and to level it off where necessary. A cylinder, in which the shield had been assembled, was then brought up and set in approximate position by the derrick boat. It was usually possible then to shut down an hour or two first one and then the other of the turbines discharging on either side of the site. On the side where the water was still, the horizontal and inclined timber struts shown in the drawing were set, and the rod and wire ties were secured to anchorages previously drilled in the dividing wall back of the cylinder. When the opposite turbine was shut down, the same thing was done on the other side. The cylinder was set with a timber underneath the Y, outside each end of which against the hood round piles were driven to hold it in place. It was then possible by setting up an instrument outside the wall of the power house on the center line of the tunnel to pull the cylinder into exact position and turn it by means of turnbuckles on the guy rods so that the hood stood exactly at right angles to the face of the power house. The cylinders were weighted down by piling material on tim-



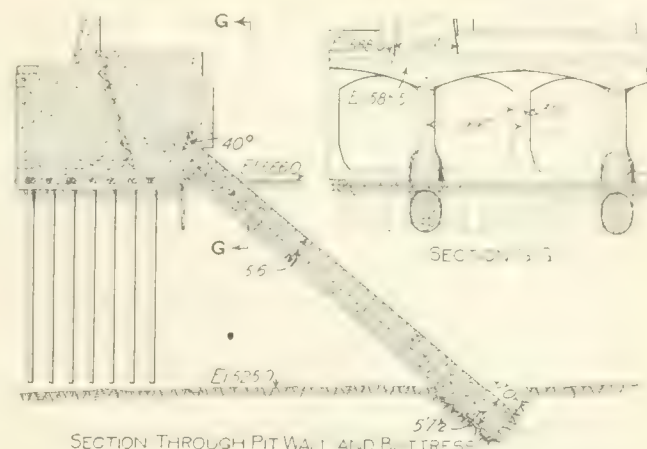
DIFFICULTY OF ANCHORING CYLINDERS CLEVERLY MET

her weight platforms supported on brackets riveted to them for the purpose. At first plenty of tunnel rings were available for weight, but later I-beams and old columns owned by the power company were employed. When the cylinder had been correctly set, the derrick boat placed an air lock on top of it and banked the hood with clay brought in on the small scows or with material dredged near by. When this was done, air pressure was turned on and a gang of three men entered the cylinder to start the shield.

HOISTING BUCKETS OUT OF INCLINED TUNNEL

The shield, which had an inside diameter of 5 ft. 7½ in., was shoved ahead by 2 or 3 jacks, the lining rings, of five cast-iron segments each, being erected in the tail in the ordinary way. The shield was shoved one ring at a time, and plates for one ring were always kept lying on the lock platform so that there would be no delay when a ring was signalled for. In spite of the difficulty of working at an inclined face, on several occasions three shoves were made and three rings set within 12 hours. The tunnel rings were made up so that a joint in each ring came at the bottom, giving a continuous line of flanges on which the bucket could slide to the bottom of the tunnel. The derrick line was never taken off the bucket, passing around a roller set in the cylinder at the top of the hood when the bucket was in the tunnel.

The bucket was lowered vertically, guides of timber being placed from the bottom door of the lock to the base of the cylinder, until it struck inclined timber guides on a line with the floor of the tunnel. These started it on its descent, and also guided it against the vertical timbers when it was pulled out. There was no danger of the bucket fouling the roller, as the latter was at a sufficient height above the upper end of the tunnel floor to allow the bucket to swing clear before the bail was within a foot of the roller. The buckets were



INCLINED TUNNELS TRANSMIT THRUST TO ROCK

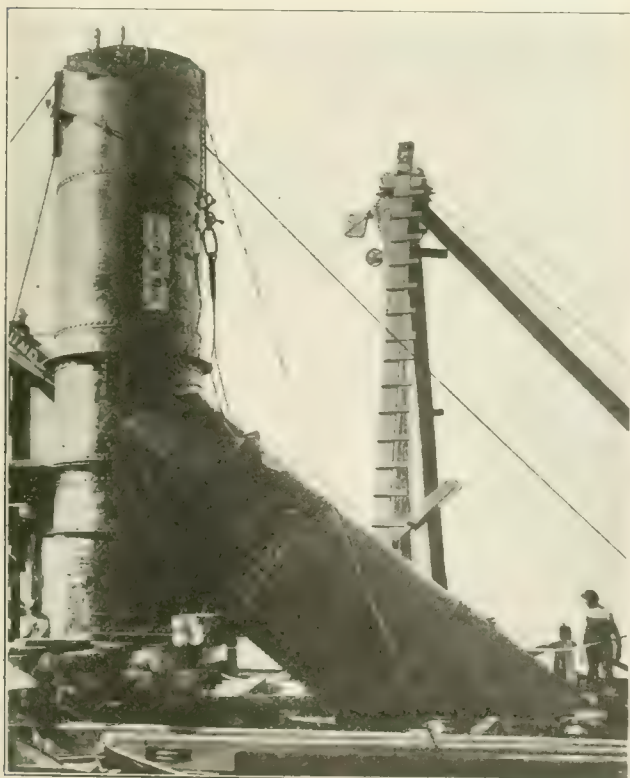
packed level full with sand and gravel, and what little spilled out on the ascent merely served to fill up the lower part of the rings and make a better track for the bucket to slide on. All the material taken out was dumped over the hood of the cylinder. Frequently, because of rapid erosion by the turbine discharge, this was not enough to keep the upper end of the tunnel covered, and more clay had to be brought in by barge. When a derrick was working a cylinder to one side, the buckets were quickly dumped over the hood by swinging them a short distance out. When a derrick was working a cylinder directly in front of it, however, it was not possible to boom down far enough to dump over the end of the hood, and a short wood chute with a hopper at the upper end would be rigged to carry the dirt to the proper point.

GROUT AND OAKUM PLACED IN LINING JOINTS

As perfectly tight tunnels were desired by the owners, cement was kept at the heading and a can of grout mixed every time a ring was set. Oakum was laid against the ring last placed, outside the bolt holes, and daubed with grout as the next plate was set. This method produced joints which were free from leakage, practically the only air lost escaping at the top of the shield. Indeed, leakage at this point became serious in the first tunnels driven, and there appeared to be a danger of blows. To prevent this, and to keep material from the top from running into the heading, small hoods 18 in. wide at the top and tapering to nothing at the bottom were made of ¼-in. plate and bolted to the cutting edge of each shield before driving was started.

BELLS REQUIRE CAREFUL SHOOTING

When each shield had been driven a number of feet into solid rock, a bell was excavated, enlarging from the diameter of the shield to a diameter of 7 ft. 9 in. about 18 in. beyond the cutting edge. For cylinders 20 and 21, deeper bells were excavated because of greater thrusts on them, one reaching a maximum diameter of 9 ft. and the other one of 10 ft. In excavating these bells, only the cut was drilled and loaded as in ordinary tunnel practice. No relievers were used, but about 25 trim holes were drilled after the cut had been shot, six sticks of dynamite being divided into small charges and every other hole loaded. This light shooting avoided cracking the rock outside the excavation limits and the danger of blowing out at the top, but required a large amount of



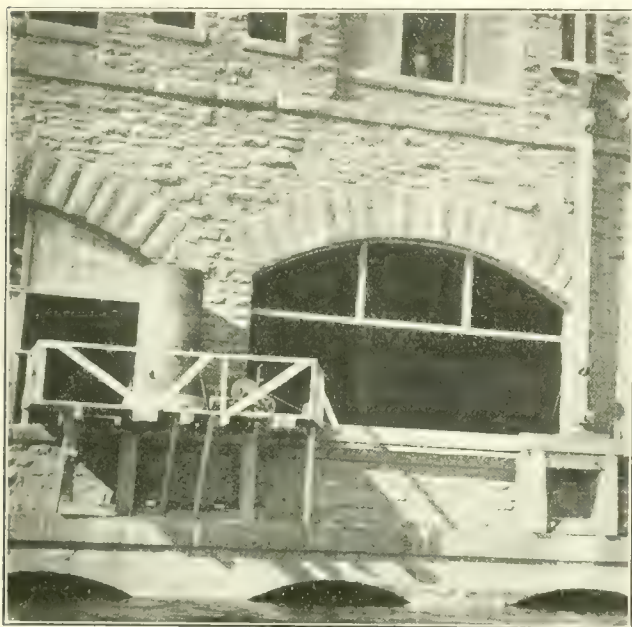
SHIELD ASSEMBLED IN Y OF CYLINDER BEFORE SETTING

trimming with chipping tools to bring the bell to full size.

After the excavation was finished, the inside of the tunnel would be washed out perfectly clean with a hose and about 80-lb. water pressure. Washing started at the top, the dirt and water running to the bottom. Most of the water would blow out of the shield, leaving a small amount of water and sand to be bailed out. The alignment of the tunnel would then be checked by instrument, so that its exact bottom could be plotted, after which a chute would be built of plank under the lock door in the cylinder to start concrete down the tunnel.

TUNNELS CONCRETED WITHIN 6 TO 8 HOURS

The tunnels were bottomed under 25 to 29 lb. of air, which made it possible to lock concrete in with considerable speed even at the first. As the concrete rose, the air pressure could be reduced until only a short time was required for a man to take through a batch. Fre-



DERRICKS WERE BRACKETED OUT FROM POWER-HOUSE WALL

quently, 15 1-yd. batches an hour were placed, and it required only 6 to 8 hours completely to fill a tunnel. Two men stayed at the bottom of the tunnel and came up with the concrete, while the third went in and out with the batches in order to wipe off the gasket on the bottom lock door each time, to prevent delays. The concrete was allowed to run down the bottom of the tunnel from the wood chute under the lock door, there being no particular object with mass work of this nature in avoiding the filling of the corners of the lining rings at the bottom with concrete which set a little in advance of the main body. The concrete, of course, came up with a horizontal surface. When this reached the point where it would overflow into the hood, a bulkhead was built at the bottom of the first lining ring and concrete was shoveled over the top of it from the chute until all but the last lining ring was packed completely full.

After the concrete had set, the hood was unbolted from the cylinder, leaving the latter clear of the upper end of the tunnel. The lock and cylinder were then re-

moved, after which the hood was dragged from around the tunnel by a wire rope bridle placed at the time the cylinder was set and tied during driving to some convenient anchorage on the dividing wall. By this arrangement the only driving equipment lost with each tunnel was the shield itself.

SECTIONAL COFFERDAMS SET BY DIVER

The next step was for one of the derrick boats, with the assistance of a diver, to level off the dirt around the upper end of the tunnel. One of the sectional wood cofferdams was then set and dirt banked around its outer end, using short sheeting where this came above the bottom. The inner ends of the side sections projected into the draft tubes, but the outer ends had to be weighted down with I-beams. Concrete to a thickness of 2 ft. was then placed under water by bottom-dump buckets beyond the edge of the mat underneath the power house around the upper end of the tunnel. It was found on pumping out some of these cofferdams that the new seal had not bonded with the old concrete, producing serious leaks. In these cases an additional seal of concrete 6 in. thick was placed over the entire floor of the cofferdam. The sides of the cofferdam were clamped around the center bracing and to the end sections by rods and turnbuckles, which were placed and adjusted by the diver. After the seal had set, the dam would be unwatered with a small pump and the pier constructed in the ordinary way. The turnbuckle rods could be taken out as soon as the coffer was dry, the water pressure being sufficient to hold the sections tight against the oakum with which the joints had been calked by the diver before pumping was begun.

RAPID PROGRESS MADE IN TUNNEL DRIVING

Considering the fact that numerous boulders had to be blasted in driving the tunnels, progress on them was not much slower than would be expected with horizontal tunnels of the same size driven in the same way. They averaged thirty-six 1-ft. 9½-in. rings apiece, one tunnel of this length having been driven and belled out in rock within 12 days. Because of the unusual nature of the work, it took 40 days to complete the first tunnel, but the others were all driven in less than half this time. After the first tunnel was finished, bonuses were offered for rapid progress, which resulted in a considerable improvement in speed.

In order to secure properly distributed support from the first tunnels driven, the power company picked out 10 cylinders to be completed first, and after these were finished specified 12 more to be done. Following the completion of these 22 cylinders the others were taken in any order at the option of the contractor. The entire work of tunnel driving took less than six months, air having been taken off the last cylinder on the morning of Dec. 30. Since that date, the cofferdam work has been prosecuted.

The construction details were designed and the work has been carried on by the Foundation Company, John W. Doty, vice-president, with W. I. Johnson as superintendent, for the Michigan Northern Power Company under the supervision of L. H. Davis, general manager and chief engineer, and of S. H. Woodard, consulting engineer.

How Technical Journalism Is Taught in a Co-operative Engineering School

Student's Loathing for the "Theme" Removed by Having Him Read Technical Journals Critically and Limiting His Work to That Which He Knows

By C. W. PARK

Associate Professor of English, University of Cincinnati

EVERY engineering student is potentially a contributor to one or more technical journals. Even if he does not chance upon suitable material for publication during his college period, he will not be long in practice before his observation or experience will give him ideas which he will wish to share with other members of his profession. It is partly on this assumption of future authorship that all students in the College of Engineering at the University of Cincinnati are given a course which consists of writing for publication, or *as if* for publication.

TECHNICAL ARTICLES ANALYZED

This sort of "journalistic preparedness" has more immediate advantages, however, which are sufficient in themselves to justify it as a part of the engineering student's training in English composition. By analyzing various articles in order to study their technique the student learns to classify them readily and to grasp their content easily. He learns where to look for general discussion and where for specific information, and he thus becomes able to collect and sift bibliography intelligently. By noting the emphasis on timeliness, originality, and practical usefulness in magazine articles he gains a better appreciation of their technical value, as well as a clearer notion of what would be an acceptable contribution from him.

From the standpoint of the teacher of composition, no better exercises could be found than a set of journalistic assignments. If the best models are followed, the student will have unexcelled opportunity to develop observation, a sense of proportion, variety of phrasing and ability to write simple, clear, smooth, and straightforward English. Best of all, his relation to his subject and audience will be the normal one of the writer who has something interesting to say and who has a definite motive for saying it effectively.

A BAN ON EMPTY GENERALITIES

The importance of this last advantage will be made clearer by a brief consideration of the conventional and perfunctory thing called a "composition," the sort of dissertation which certain authors' relief associations advertise to furnish on any subject at a moderate rate per page. The regulation composition is pretty certain to be of the discussion type—that is, it is a disquisition on some general topic, such as "Concrete Buildings," "Asphalt," "Submarines," "Colonial Architecture," "Scientific Management," "Industrial Preparedness," "Electric Furnaces," "River-Improvement Work," and so on. Now there are persons whose experience fits them to write interesting and valuable discussions on these subjects, but such persons are not likely to be found among college undergraduates.

The magazine editor, a part of whose business is to protect his public against uninteresting and unprofitable reading, has no use for general discussions submitted by young writers. The student who attempts to write on one of these topics must either deal in empty generalities or present a warmed-over rehash of some one else's discussion. In other words, he must simply assemble the ready-made parts into the most respectable unit he is able to make. This process of putting standard parts of a composition together, which is often called "preparing a paper," is not without value, especially if skill is used in selecting and fitting the pieces. There are even rare cases in which the material is completely rewrought into what is virtually an original product, and I am far from denying, of course, that certain kinds of second-hand writing, such as reviews and abstracts, call for considerable skill.

VAGUE ASSIGNMENTS DANGEROUS

The point I would make here is that the general discussion type of composition as it is nearly always written by college students is not a vital, nor in the best sense an original, exercise. It may be necessary to use it extensively where teachers and students are unable to find live material, but certainly it is a type of exercise that does not call for any degree of alertness, originality, or first-hand observation on the part of the writer. The vagueness of the assignment and the consequent freedom of treatment may be a dangerous temptation for the inexperienced writer. At best, the general composition develops a certain faithfulness and industry in the performance of a perfunctory task. At worst, it begets a helpless state of dependence upon printed sources of material. Instead of welcoming as a challenge and an opportunity the discovery that nothing has been published on a given subject, the writer who has fallen into the dependent attitude simply gives up in despair.

STUDENTS RECEIVE SPECIFIC ASSIGNMENTS

Contrast with the dry, academic, general discussion type of writing just noted a specific assignment for a real technical article. Instead of "Concrete Buildings" and the Reader's Guide, the student is given the following instructions:

(A)

Mr. _____, engineer for the _____ Construction Company, a local concern, has recently designed a new type of adjustable shore. Write this up in a crisp news article as if for publication in the (name of a technical journal). Include photographs or sketches. Not more than 600 words.

Or, instead of the general topic "Asphalt," which would probably drive him to the Encyclopedia Britan-

nica, the student is given some such suggestion as this:

(B)

The _____ Commission has just made a series of tests on a half mile of road paved with Kentucky rock asphalt. Give full details of the construction of this road and of the nature of the tests in an article for _____. Get photographs, curves, and tables of data. About 1500 words.

The foregoing typical assignments are specific problems in writing, and because they are definite, tangible and vital they arouse interest in the student—a thing which the vague injunction to write a “composition” rarely does. Still more interesting and beneficial than these assignments or “stunts” are the projects which the student makes out and completes on his own initiative.

DEVELOPING “NOSE FOR COPY”

Using assignments like A and B as suggestions, and following some models which have been studied in class, he develops a “nose for copy” and is able to write a variety of articles from his immediate observation or experience. Students who take the co-operative course are particularly fortunate in this regard, for their alternate bi-weekly periods of work in the practice of engineering constantly afford suggestions for technical articles, ranging all the way from shop kinks or field and office notes of less than 500 words to long articles of the descriptive or the report type, which may run to 4000 words.

Many of these articles are actually published, but whether they are or not, the stages of their preparation are the same. The student gets a promising idea, decides upon the scope of a possible article, and tests his subject for the requirements of live interest and engineering value. Then by means of the *Engineering Index*, the *Technical Arts Index*, and the indices to the most likely magazines he learns whether or not articles have been written on the phase of the subject which he proposes to discuss. Unlike the dependent writer of a “composition,” he rejoices on finding that nothing has been published on the subject, and that his article will not therefore be a duplication of any previous one.

ARRANGEMENT OF MATERIAL STUDIED

The originality and engineering value of his idea are further tested by the criticism of his fellow-students and technical instructors, to whom he presents the material in co-ordination classes. He is now ready to consider the type of article which he will write, the arrangement of his material, the points which he will feature or emphasize, the use he will make of photographs or sketches, and various other matters relating to the organization of his article. Although most editors prefer to supply headings themselves, the writer will find it worth while to get a title which indicates as clearly as possible the subject and the method of treatment.

By giving careful attention to all these preliminary matters he will have greatly simplified the actual writing of his article. As a rule, however, he will find it necessary to revise his first draft, and especially to work over his beginning to make it clear and direct, for long and

formal introductions, of course, are entirely out of place in an article of this kind.

After he has fully revised the manuscript, has omitted unnecessary passages, and has smoothed the rough places, he is ready to put the article in proper mechanical condition. If he cannot typewrite it himself, he should see to it that the copy which the stenographer receives is legibly written and correct, and he should give explicit instructions as to spacing, centering, and other details which will improve the appearance of the manuscript. At the University of Cincinnati no credit is given for copy which does not conform to certain mechanical standards.

To follow an article through these various stages to its completion is by no means an easy task, but the student realizes that it is a profitable one, and because it is in all respects his own work he takes interest and pride in seeing that it is well done. Many short articles are much easier to prepare than would be suggested by the foregoing outline, but whether the successive steps are taken quickly or slowly, all these matters should be given attention. There is nothing better for developing mental alertness and skill in writing than the rapid preparation of a variety of articles. It is more than a coincidence that a large proportion of literary men have served some kind of journalistic apprenticeship.

ARTICLES CLASSIFIED BY TYPES

Without entering upon a minute classification of technical articles, we may note, in passing, the principal types and their relative importance to the young writer. Broadly speaking, the articles which make up the body of the average technical magazine may be grouped under three heads: Discussion, report, and descriptive articles. The first of these includes editorials and letters expressing opinion, but refers chiefly to long articles on general subjects, the style and method of treatment of which may vary according to the author's discretion—and he is assumed to have reached the age of discretion. Discussions of articles by persons of long experience, mature judgment, and known general fitness to deal with a subject are always in demand, and properly so. Anyone would be glad to read a discussion article by Howard Coffin on “Industrial Preparedness,” by Samuel O. Dunn on “Government Ownership of Railroads,” and so on. Likewise, editorials and signed letters of opinion in the more prominent journals may be safely assumed to be thoughtful, suggestive, carefully reasoned articles. Except as an exercise, however, the discussion type of article should hardly be attempted by the beginner. He is not in a position to write editorials, unless for his college paper, and his sense of proportion should restrain him from offering either letters of opinion or long discussions as contributions to a technical journal.

REPORT TYPE OF ARTICLE

The report type of article, though less common than the others, deserves special notice because of its scientific character. In form it resembles the reports of laboratory tests which students are often called upon to make. That is, it consists of a statement of the object of the investigation; the theory on which the tests were made; the apparatus used; the procedure; the results, shown in tabulated form; and the conclusions reached.

This kind of article is usually technical in language and is addressed particularly to specialists. The data constitute its chief interest, and the written part is intended merely to state the purpose, vindicate the method, and explain the conclusions of the investigation. Because the writer must adhere rigidly to this outline, the report type of article is an excellent exercise in logical arrangement and clear, concise statement.

Students are sometimes in a position to write a report article; for example, one student at the University of Cincinnati based an article on a series of tests which he had made on a motorcycle engine by means of a blower fan. Another is now at work on an article resulting from tests of case-hardening compounds. As a rule, however, the actual preparation of such articles for publication is done chiefly by older men who have specialized in some phase of engineering research.

THE POINT OF VIEW

By far the most in demand is the descriptive type of article. Dealing as it does with a specific subject of timely interest, it constitutes a kind of technical reporting, in which the details are selected and presented according to the interest of a given body of readers. It often happens that the same occurrence, differently reported, may be found written up in the newspapers and in the technical journals, so that a direct comparison may be made between the methods of the respective reporters. If the occurrence is the failure of a bridge or a dam, the newspaper reporter features the human interest details, the loss of life and property, together with incidents such as narrow escapes and heroic rescues. He makes but little mention of technical matters and speaks of them only in general terms, such as the layman, and the reporter, can readily understand. The trained engineer who writes the same story for a weekly technical journal omits the spectacular incidents and the heart-interest scenes. Both in his language and in his illustrations he maintains the scientific point of view and presents the details of stresses and strains, foundations, and other technical matters. His writing is a specialized kind of reporting for a special group of readers.

A large proportion of the articles, particularly in the weekly technical journals, belong to the class of news stories which feature novel methods or equipment or the solution of difficult practical problems in engineering. These descriptive articles are written in a smooth, brisk, newsy style, and much of the thought is expressed in terms of significant photographs and sketches.

SHORT DESCRIPTIONS BEST FOR BEGINNERS

It is in the writing of such specific articles, especially in the short ones which deal with new "kinks" in engineering practice, that the beginner finds his best opportunity. A new method of locating trouble in the repair of electrical apparatus, a novel design for a foundry pattern, a device for hoisting materials on construction work—these are only a few suggestions of the sort of material which is most easily obtained and of the kind of articles most in demand. Since one of these brief descriptive sketches, if well written, has all the requisites of a longer article, a course in technical journalism may well center about such assignments, with only enough of the other types to familiarize the student

with their chief characteristics. For the latter purpose and for exercise in phrasing, even the writing of original advertisements and "trade write-ups" may profitably be attempted, but the descriptive type of article should be the backbone of the course, just as it is of the technical journals themselves.

MANY STUDENT ARTICLES ACCEPTED

The students in the co-operative engineering course have had numerous articles accepted, varying widely in length and kind, the remuneration being from \$3 to \$35. There is no denying that the prospect of a check is a strong incentive for the preparation of an article—perhaps even stronger than the prospect of seeing one's name in print. Although the students would be given credit in English for these articles, whether published or not, it is an added satisfaction to know that their compositions have a commercial as well as an academic value. If some one were to offer cash prizes equivalent to the returns from these articles and stipulate that the award be left to a committee, I should feel inclined to ask that the money be diverted to some other purpose. It seems to me decidedly preferable that the technical articles written by students should continue to be tested on their merits by the normal, commercial standards for the acceptance of technical literature.

The following partial list of student articles accepted from time to time will indicate something of the variety of subjects and kinds of articles within the reach of engineering students:

- Howard, W. R.—Screening and Concrete Plants for Building Use Gravel from Cellar Excavation. *Engineering Record*, Vol. 73, No. 15, page 483.
Descriptive type, based on experience in co-operative work. Photographs and sketches. 2500 words.
- Todd, Fred C.—Floating Concrete Plant at Dam 39, Ohio River. *Engineering News*, Vol. 75, No. 14, page 661.
Descriptive type, based on experience in co-operative work. Photographs and sketches. 800 words. Contrast this with the sort of general discussion that would be written on the topic "River Improvement."
- PHELPS, S. B.—An Inexpensive Base-Plate Pattern. *The Foundry*, Vol. 43, No. 11, page 466.
Descriptive type, based on experience, "Shop Kink." Sketch, 500 words.
- Oster, Eugene—Comparison of Lead-Sulphuric and Edison Types of Storage Battery. *Power*, Vol. 38, No. 21, page 716.
Combination of report and discussion type. Informal investigation of the two kinds of battery. Photographs. 4000 words.
- Kuhlman, L. G.—Slate Drilling. *American Machinist*, Vol. 41, No. 6, page 247.
Semi-report type. Notes on experience in co-operative work. Sketches. 700 words.
- Sharkey, W. E.—A Fan Method of Testing Motorcycle Engines. *American Machinist*, Vol. 41, No. 21, page 917.
Report type. An account of an investigation made partly for the co-operative form and partly as a laboratory test at the university. Photographs and sketches. 1600 words.
- DaCamara, H.—Hoists for Reinforcing Steel. *Engineering News*, Vol. 73, No. 8, page 395.
Descriptive type, based on experience in co-operative work. Sketch. 400 words.

Government Reports on Stream Measurements in Columbia River Basin

A report presenting the results of co-operative work between the U. S. Geological Survey and the states of Washington, Montana and Idaho in measuring the flow of streams in 1913 has just been issued. The streams measured are those flowing into the Pacific Ocean in Washington, and the upper Columbia River and its tributaries above the mouth of the Snake River. The report, which may be obtained from the director of the United States Geological Survey, is known as Water-Supply Paper 362A, and is intended to be of service to engineers interested in utilizing the streams in this area.

Training in Thought Is the Aim of Elementary English Course as Taught at M. I. T.

Instruction Methods Presuppose That Clear Thinking Produces Clear Writing—Much Weight Is Given to an Appreciation of Relation Between Literature and Engineering

By FRANK AYDELOTTE

Professor of English, Massachusetts Institute of Technology

OUR elementary English course at the Massachusetts Institute of Technology, and especially that part of the first year's work which I have been asked to describe for the Engineering Record, might be characterized as an attempt to translate a certain demand, which is voiced on all sides by successful members of the profession, into a practical measure of engineering education. The question as to the kind of an English course engineering students should have depends upon the larger question whether one takes a narrow or a broad view of the vocation for which these men are being prepared. One may regard the engineer as a high class mechanic, not a scientist but a man who has mastered certain principles of science which can be turned to industrial uses, an expert, somewhat set apart from mankind in general, whose field is the world of dead matter and force, which he manipulates under the direction of other men without much regard to the general human significance of his work. On the other hand, one may regard him as a member of an intellectual profession which has for its object the control of the human as well as the material forces of nature, which has or is now forming a code of ethics according to which it will develop those sources of power in nature for the use of man—a profession the members of which, working in co-operation, consider themselves the trustees of the whole body of natural knowledge placed at their disposal by modern science, and who consider their duty to be to add to this knowledge and to use it for the realization of the highest aims of society.

TECHNICAL PROFICIENCY NOT ENOUGH

No reader of any large number of the essays and addresses in which practical engineers of the present day discuss these problems can be in doubt as to the direction in which they would have the profession go. That engineering is an intellectual profession, the mission of which is to be one of leadership in working out the problems of the modern world and in serving its highest interests, is the claim of many of the most distinguished engineers of the day; and these men demand from engineering schools not merely technical proficiency but also that development of character and that liberal cultivation, that capacity for original thought about human as well as material problems, which will enable technical graduates to play a worthy part in the engineering world when the period of their practical apprenticeship is ended and they are ready to take the places vacated by the present leaders.

This high conception of the profession of engineering is, of course, the fundamental justification of literary studies in a technical school; and it seems very important, in the practical teaching of English literature and composition, to make clear at the outset the

bearings of this study on the wider usefulness of the engineer. The course about which I have been asked to write is planned with exactly that aim in view. The case for composition is in the end the case for literature. The widespread demand that our college men, graduates of technical schools and of colleges of liberal arts alike, should be better able to write and speak their mother tongue is really a demand that they have a better literary education. A man's writing reflects his habits of thought, and it is simply impossible to give him a cultivated style by any other method than by making him a cultivated man.

The average engineering student has too narrow and too mechanical a view of his future profession. He does not hold this narrow, materialistic, mechanical opinion of his calling as a result of thought and choice, but rather vaguely, from lack of thought, in obedience to a real or imaginary spirit of the age (perhaps one ought to say, of the age which is just now passing), which it has never occurred to him to criticise. He is ready to take hold of a broader conception with all the enthusiasm and ardor of youth once it has been pointed out to him.

MAKE STUDENTS THINK

We begin our study of English literature at the Institute of Technology with some consideration of the status and significance of the profession of engineering. Using as a basis some essays by practical engineers, we ask our students to consider the question whether engineering is a trade or a profession, what the difference implies, what is the meaning of professional spirit, how the ethics of existing professions differ from those of business or of the mechanic arts. We pass from this, again using as a basis for our work the writing of various men prominent in the engineering world, to the question of engineering education: What kind of training is necessary to fit a man to take a worthy place in the profession if it follows the lines laid down by the leaders of the present day? We ask the student to compare his own aims in entering a technical school with the professional demand as codified by Dr. Mann in his recent investigation of technical education conducted on behalf of the Carnegie Foundation and the five national engineering societies.

The object of all this work is to make the student think more seriously about his own vocation and the preparation he needs for it. Instead of telling him what he should believe we undertake to make him think it out for himself. We do not hand out his ideals to him for the reason that he will not act on them unless they are his own. We ask him constantly to discuss these questions as they look to him, orally and in his themes; they are, of course, questions on which it is

very important that he should have an opinion and they are questions which excite his keenest interest.

Following the topic of engineering education we pass to that of pure science versus applied. Is the interest of the engineer solely in *how* things are done, or is it also in the *why*? What is the relation of practical engineering to scientific research? Is the work of the engineer the application of established formulæ to practical problems, or is it the solution of problems by scientific methods? As a basis of all this work we use essays by scientific men, and we ask the class as before to discuss in writing and speaking the application of these ideas to their own situation and their own studies.

RELATION OF SCIENCE TO LITERATURE

Finally we come to the question, What is the relation of science to literature? Here we ask the class to read a set of essays by scientists and literary men dealing with this subject and to work out in their discussion the relations between these two great bodies of thought which divide between them the material of our civilization. Each stage of this progress from engineering to literature harks back to all those preceding, and the whole ties itself together in a connected train of thought which these paragraphs will suggest, though, of course, enriched and diversified and illustrated in ways which cannot be suggested in so brief an outline.

The end of the half year's work is to give the student some notion of these alternative conceptions of engineering which I alluded to at the beginning of this article and some idea of what each implies. The question is not settled for him, perhaps, but it is opened. There is a real connection between the various problems with which he has been confronted. That conception of engineering which tends to divorce it from literature and from human problems, on the one hand, tends to divorce it from science on the other, tends to make it more of a trade than a profession, tends to limit the usefulness of the engineer to society by restricting him to the performance of merely mechanical tasks. Even the elementary student will see this, especially when he hears it from the mouths not merely of his English teachers but of practical engineers as well. He will see it and, in most cases, he will form for himself a broader conception of his calling as one dealing with human as well as material problems and needing for its practice a humanistic as well as a technical training. He comes to realize the intimate connection of the work he has chosen with science on the one side and literature on the other. He conceives himself as having a place in the world not only as a money-maker but also as a man. He is brought to the point where he has some conception of literature as a comment on life, as the collected wisdom of the race for the solution of its problems, as one expression of that beauty which makes life worth living.

HOW ENGLISH COURSE IS CONDUCTED

Ideas of this kind sound very "theoretical" and very far from practical class work in a practical engineering school. They may seem to the average reader all well enough for a lecture on poetry, where the lecturer may be allowed to say somewhat more than he means for the sake of emotional effect, but likely to pass high over the heads of technical students. As a matter of

fact lecturing about them is the last thing we do. I can illustrate this by pausing for a moment to indicate more in detail how our work is conducted day by day.

Let us take, for example, the point with which we begin, the engineering profession. On the first day of the term, before the class has read anything on the subject, the instructor asks the question, What is engineering? All sorts of answers come back, mostly vague, or good answers quoted from somewhere but vaguely understood. Without saying dogmatically what is wrong and what is right (we dogmatize very little from one end of the course to the other), the instructor follows the first question with others: What is the difference between an engineer and a carpenter, or a plumber, or a research professor of chemistry? Is engineering a trade or a profession? What do these terms imply? What makes medicine a profession? As a result of an hour of such discussion, which is likely to wax very hot, the class is ready to read essays on the subject by engineers with avidity. These essays are taken up in class one by one and their bearing on the previous discussion brought out.

"LIVE" TOPICS FOR THEMES

For a theme the class may be asked to explain the difference between some mechanic and some engineer whom they know in the flesh. Or the different members may state more carefully rival points of view which they have argued about in class. All this discussion serves two ends: It trains the men to think more clearly, criticising their own hasty opinions, and to say carefully and exactly what they mean. And the result of all of it, carried through the whole list of topics, is to build up in their minds a body of ideas which they would never catch from lectures or from reading unaccompanied by discussion. The function of the teacher is to direct the discussion and focus it upon the important issues. If he gives his opinion it is as an individual rather than as a source of authority. His purpose is to stimulate and bring out differences of opinion, objections, and contradictions, that the class may try them and decide on their validity. This method has more in common with that of Socrates than with that of the typical German professor. It is not an easy way of teaching, but it is extremely effective.

COLLECTION OF ESSAYS USED

The volume of essays on which this work is based is arranged according to topics, with several essays under each, in the order in which I have taken them up. They are (excluding the first), "The Engineering Profession," "Engineering Education," "Pure Science and Applied," "Science and Literature" and "Literature and Life." This last section contains half a dozen essays illustrating in elementary ways the idea of literature as a "comment on life," and this forms a kind of summary of all that has gone before and as well a direct preparation for the further study of literature in the second year.

The first section of our collection has for its title "Writing and Thinking," and that title will suggest the method of the composition work which accompanies the reading. That work is based on the principle that the first rule of good writing is clear thinking. We grade our themes primarily on the ideas expressed in them.

We do not neglect faults of expression, but our ideal is one of content as well as of form. Where faulty expression is due to careless thinking, as in most cases it is, the trouble is traced back to its source.

For composition work of this kind the ideas about engineering and literature which we have been developing make admirable material. The men are interested and stimulated by them. The differences of opinion which arise make them eager to talk and to write. These conditions, the fact that they have something to say and the desire to say it well, are most important for effective work in composition. Of course, the men are unequal. It cannot be maintained that all students do well in such a course as this. To a certain type of mind the work seems "up in the air," with nothing tangible to learn and repeat, only ideas to discuss. The best students take to it keenly; the average men show marked improvement in the care with which they read and in the clearness with which they talk and write, while that student is dull indeed who does not produce some themes which are real expressions of his own thought and of his own personality.

INDIVIDUALITY ENCOURAGED

This work we make markedly individual throughout. We encourage independence and try to be patient with every point of view. Every effort is made to induce the student to think for himself. To this end we find a large number of personal conferences, which are a tradition of the English Department at the Institute, of the utmost value.

Work of the kind which I have just outlined seems to us, as I have said elsewhere, to have more value for strictly technical purposes than a course occupied exclusively with what is called "technical writing." No matter what the subject to be discussed the problem of writing is much the same. The student who can think straight, who can handle complicated ideas, who can balance arguments and marshal them to the support of his conclusions, can handle any technical subject within the range of his technical ability.

This does not mean that the student will not get great value from instruction in technical writing.

COMMON SENSE, PERSPECTIVE AND IMAGINATION

There are, of course, tricks in every trade, but the tricks are much easier to acquire and much less important than general intelligence. There is no "fool-proof" method of writing engineering reports. An engineer who relies on a stereotyped form will turn out a machine-made product, devoid of real vitality. The problem is one of common sense, of perspective, of power of clear thought and clear expression, and of imagination to grasp the point of view of the man who is to read the report.

But the value of the work I have described is not limited to its bearing upon the actual writing which the engineer must do in the practice of his profession. Even more important is its educative value to the man, the approach it gives him to literature, the intellectual interests which it opens up to him, not as matters foreign to his work but as vitally connected with it. If the engineer is to have his full value to society he must view society broadly and address himself to the solu-

tion of its problems, human as well as material. In the education of this broader engineer, whom society so badly needs, the study of the mother tongue must be more than the acquirement of facts or a superficial accomplishment; it must be a training in thought, the influence of which is to clarify and humanize the student's character and his aims in life.

Old Piers Struck in Driving Coffers for New Ones Prove Watertight

Overtaken Masonry of Bridge on Susquehanna River Carried Out by Johnstown Flood of 1884 Still in Good Condition

By F. P. KEMON
Atlantic City, N. J.

STONE piers that had lain at the bottom of the Susquehanna River since they were overturned by the Johnstown flood in 1884 were so well preserved that they were used as part of the cofferdam walls in building a railroad bridge at Milton, Pa.

The bridge, built for the Philadelphia & Reading Railroad by the Robert Grace Contracting Company, of Pittsburgh, was described in the Engineering Record of May 20, 1916, page 676. In building the coffer-



MASONRY OF PIERS OVERTURNED IN 1884 STILL WATERTIGHT

dams, sections of the steel sheeting struck these piers, which were part of an old bridge washed away 32 years before.

As the piles could not be driven into the piers, the pumps were started after the piles were driven as far as possible. Practically no water leaked through the old masonry, showing the remarkably good condition of the old mortar. Some of the piers covered about two-thirds of a cofferdam and were broken up with great difficulty. Even after they had been torn away to the edge of the cofferdam and excavation carried 12 ft. below the foot of the piling, the remaining wall was still watertight.

Tests Made to Determine Lateral Resistance of Wire Nails

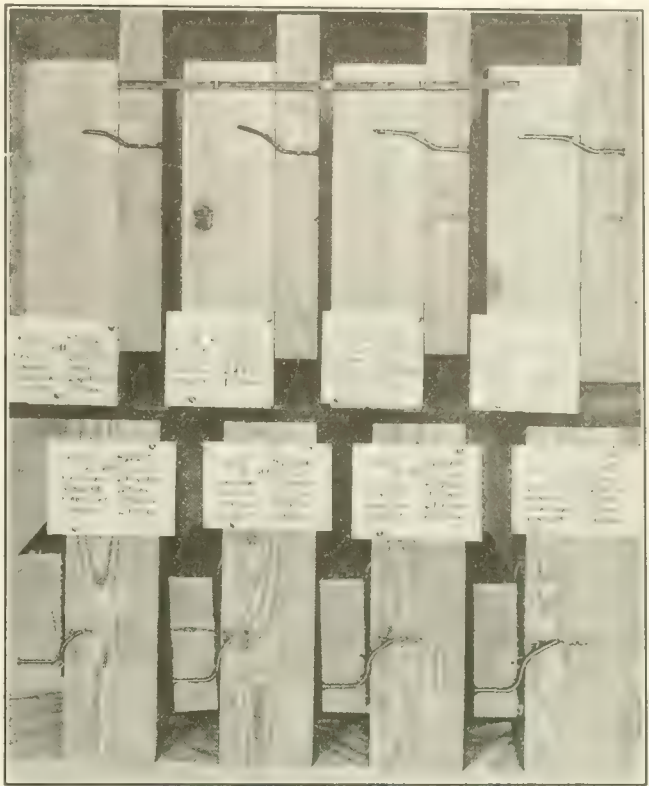
Results Reported of Part of Extensive Investigation at Forest Products Laboratory Into Strength of Various Kinds of Joints

By THOMAS R. C. WILSON

Engineer in Forest Products, Forest Service

AS A PART of a rather extensive project dealing with the strength of various kinds of joints and fastenings, some tests have been made at the Forest Products Laboratory, Madison, Wis., to determine the resistance to lateral forces of several sizes of common wire nails. This series is not yet complete, but it is thought that the results so far secured may be of interest.

These tests were made on the larger sizes of wire nails (30d. to 60d.), driven into thoroughly air-dry (average moisture 13.8 per cent) longleaf pine of fairly good quality. Data on the strength of the timber are given in Table 1. Table 2 gives the average results—slip, load per nail and load per pound of nails both at elastic limit and at maximum load. Figs. 1 and 2 show the size of the test specimens and the arrangement of the test sets in the machine. For convenience of reference the piece through which the nails are driven is called the "cleat" and that receiving the points of the



BENDING OF NAILS RESULTING FROM TESTS FOR LATERAL RESISTANCE

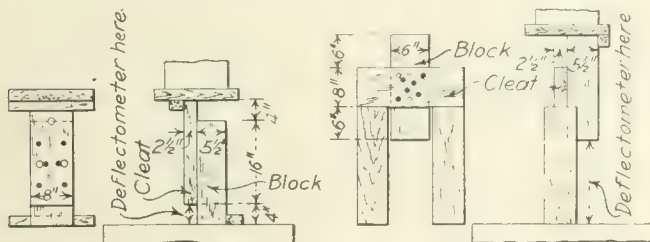


FIG. 1
Timbers with grain parallel loaded parallel to grain.

FIG. 2
Timbers with grain at right angles to each other.

FIGS. 1 AND 2—DIMENSIONS AND DETAILS OF 6-NAIL JOINTS
Open circles mark position of nails for three-nail joint. In Fig. 1 cleat is shifted 8 in. endwise.

TABLE 1—COMPRESSIVE STRENGTH OF TIMBERS COMPOSING JOINT
STRENGTH OF TIMBERS, IN POUNDS PER SQUARE INCH

	Parallel to grain*		Perpendicular to grain†	
	Block	Cleat	Block	Cleat
Timber for tests, Fig. 1.....	6,550	8,340	875	1,315
Timber for tests, Fig. 2.....	7,850	7,850	1,025	1,425

*Maximum crushing strength from tests on 2 x 2 x 8-in. specimens.

†Fiber stress at elastic limit from tests on 2 x 2 x 6-in. specimens.

nails the "block." In order to prevent splitting, 3/16-in. holes were bored in the cleats for each nail. The blocks were not bored. Care was taken not to place any of the nails in checks, knots, or other defects or irregularities.

The following points have been noted from these tests and results. They may not apply to other sizes of nails, species of timber, thicknesses of cleats, or depths of penetration of nails.

1. The elastic limit is quite well defined and at a comparatively small deformation. Ability to absorb shock or impact is measured by the product of load and deformation, and to insure safety it is essential that both be kept well within the values at the elastic limit. Consequently this small deformation at the elastic limit points to the need for caution in the use of nailed splices where subjected to shocks such as are imparted to scaffolding, staging and other temporary construction by moving loads and the vibrations of machinery.

No definite relation between size of nails and deformation at the elastic limit is apparent.

2. The averages show greater loads per nail in six

TABLE 2—LATERAL RESISTANCE OF NAILS IN AIR-DRY LONGLEAF PINE

Character of joint	Size of nail	Load, in pounds—				Slip, in inches—	
		Per nail		Per pound of nails—		At elastic limit	At maximum load
		At elastic limit	At maximum load	At elastic limit	At maximum load		
Timbers with grain parallel, load parallel to grain ¹ —Fig. 1.....	30d	355	779	8.520	18,700	.021	.54
	40d	394	845	7.100	15,220	.026	.58
	50d	450	1,261	6.300	17,660	.019	.69
	60d	422	1,144	4.640	12,580	.018	.70
Timbers with grain at right angles, load parallel to piece receiving points of nails ² —Fig. 2.....	30d	333	783	8.000	18,790	.034	.88
	40d	389	1,125	7.000	20,270	.028	1.08
	50d	544	1,615	7.620	22,600	.036	1.18
	60d	559	1,644	6.450	18,080	.039	1.32

¹Each value based on four tests of 3-nail and four of 6-nail joints.

²Each value based on two tests of 3-nail and two of 6-nail joints.

out of eight cases for 3-nail than for 6-nail joints. Individual tests are far from consistent in this respect, and it seems probable that the load per nail is independent of the number of nails in the joint.

3. It might be expected that increasing the size of the nail would increase the strength of the joint. That this does not always happen is shown by the fact that in average load per nail, both at elastic limit and at maximum, as given in Table 2 for nails in timbers parallel to each other, 50d. nails excel 60d. Moreover, in efficiency per unit weight the smaller nails seem in general to have the advantage.

4. It would also seem that the nails had greater holding power when the timbers cross each other than when they were parallel. If the better quality of the timber used in the first-mentioned tests be taken into account it seems probable that the direction of the cleat with respect to the block has little influence on the loads. However, the deformation or slip, both at the elastic limit and at maximum load, is consistently and appreciably greater when the timbers cross each other.

DIRECTION OF LOAD

It would seem reasonable to expect that the direction of the load with respect to the grain of the block would have more influence on the results than does the direction of the cleat with respect to the block. No data on this point are available, as in all the tests made the load was parallel to the grain of the block.

One test set with each size nail and each of the two relative directions of timbers, sawn through in the plane of a nail, is shown in the photograph. These pictures are not quite comparable, since the tests shown in the upper row were discontinued soon after passing the maximum load, while those in the lower row were continued until the load decreased to approximately one-third the maximum.

Oregon Is Confronted by Unusual Highway Problem

State Engineer Calls Attention to the Magnitude of the Work and Suggests Division of Authority

OREGON, with a population density only one-seventh that of New York State, has practically the same mileage of state and county roads. The present condition of these roads probably parallels that of its eastern sister before the advent of the automobile. Oregon's topography, on the other hand, presents an unusual obstacle to easy road-building; yet the problem must be faced and solved if the state is to maintain its progress, according to John H. Lewis, state engineer, from whose address before the Commonwealth Conference, held in Portland, Jan. 3, the following matter has been abstracted.

ESTIMATE OF COST LARGE

Estimated on the basis of economy, \$75,000,000 would be required to bring the 3500 miles of strictly state highways up to modern standards. This is exclusive of roads within government reservations. An additional \$160,000,000 would have to be spent by the counties to construct the secondary, or county, roads, of which there

are about 8000 miles. No estimate is made of the cost of building 33,000 miles of local or district roads. These figures put the completion of the work rather far into the future; but it is expected that measures will shortly be taken to put certain main traveled roads into condition so that they may carry year-around traffic.

Chief among the trunk lines is the Pacific Highway, running from Portland to the California line, a distance of 350 miles. Of this, 26 miles is paved, and a still greater length is surfaced with crushed rock or gravel. There are certain stretches, however, which are impassable during the winter months.

Other designated main routes, such as the John Day Highway and the Coos Bay-Florence-Eugene Highway, have short sections where no road has even been surveyed. Were these sections opened and put in condition, the distance between important points would be considerably shortened and convenient outlets afforded—for instance, from the Willamette valley to Coos Bay and Umpqua and Siuslaw harbors, where extensive improvements are nearing completion.

NECESSITY FOR STATE CONTROL

It is recognized, however, that any highway upon which state funds are to be expended should be designated by the legislature, at least as to the cities and towns to be touched. Only in this manner can the decision remain free from small local influences and the results serve the commonwealth as a whole to the most efficient degree. Similar reasoning suggests that the county courts have complete jurisdiction over the routing of such highways as naturally would be under their control.

Drawing on the experience of other states, the work even on county roads should follow the standards of materials, construction and accounting approved by the State Highway Department, and the cost of maintenance should fall on those benefited.

Work of this importance and extent demands efficient state and county organization. While the purely executive work of construction could be left to the counties, the technical department, Mr. Lewis believes, should be maintained by the state.

Traffic Regulation and Road Repairs Under Modern War Conditions

Junior officers of the French Army, many of whom in private life occupy high positions in business, seem to have adapted themselves swiftly to the new life so different from their regular occupation. At every road intersection one of them is posted to direct the traffic, and they do so with all the efficiency of the members of a city police traffic squad. Never during his sojourn with the French armies has the correspondent of the Associated Press observed any serious congestion. Occasionally a German long-range gun will tear great holes in the roads in the endeavor to prevent reinforcements coming up or the approach of ammunition columns. At once large squads of men supposed to be enjoying a rest from the rigors of the front line are put to work to fill the gaps with fresh macadam, and huge steam rollers appear to level the surface. Other men come on with tar-pails and brushes and coat the surface to prevent the rising of dust.

Making and Filing Valuation Maps—Part II

Requirements of Interstate Commerce Commission Entail Much Work, Which Should Be Carefully Organized—Will Result in Invaluable Uniform Records

By JAMES G. WISHART

Office Engineer, Chicago, Rock Island & Pacific Railway

[IN LAST WEEK'S ISSUE, beginning page 263, the author discussed the government's requirements as to maps and profiles, the desirability of utilizing old filing equipment, and the Rock Island's method of making and filing right-of-way and station maps. In this issue he explains the somewhat different way of handling profiles, the organizing of the work and the value of the records being obtained.—EDITOR.]

PROFILES are filed on the same system as the right-of-way maps. Cardboard boxes divided into nine sections, as shown in Fig. 5, are fitted into each compartment. These are made 12 in. deep, and each section readily accommodates a roll of the same length as the right-of-way maps. Diagram maps similar to those used for the right-of-way maps are placed on the inside of the door to each compartment. The numbering of the profiles is slightly different from that for the maps. The horizontal rows of profiles are lettered and the vertical rows are numbered. Capital letters are used for the current record profiles, lower-case letters for those which have been superseded and the letter V prefixed to capital letters for the office copies of the profiles filed with the commission in connection with the valuation.

The same letter and number are assigned to the three classes of profiles for the same portion of line. For example, the current profile for the line from Tiptop to Sagville is indexed H-7; the valuation copy would be VH-7 and the superseded profile h-7. The advantage of this system of numbering can be readily appreciated by any engineer, as the number of one class of profile being known, the other two classes may be found without reference to index or diagram map.

NO CARD OR BOOK INDEX REQUIRED

The principal advantage of the method of filing and indexing described is that no card or book index is required except for record purposes. Any right-of-way map, station map or profile can be instantly found, if in its proper place, if the state in which it is located is known. Filing by states eliminates the liability of having to change index numbers or shift tracings to different compartments in the future, as often occurs where filing has been done by operating divisions or other less permanent subdivisions of the system. No mention is made in the title of the name of the operating division or district.

Filing in tubes or boxes without the use of rubber bands or other forms of fasteners to prevent the rolls from unrolling preserves the tracings. The extra length of clear tracing cloth at each end serves as a wrapper and prevents the drawing from becoming soiled; and although some will object to the leaving of this extra

cloth at each end of the roll, which at first appears as a waste, I have found that many benefits are derived from the practice. The saving of time alone when making blueprints and the continued possibility of securing legible prints from old tracings made in this way more than repay the cost of the additional cloth used.

Original tracings are placed in one set of cases to be used for current record purposes. Lithographic reproductions on tracing cloth, exact duplicates of those filed with the Interstate Commerce Commission, are filed, on the same system, in a separate set of cases assigned to valuation records, and are kept unaltered as a permanent record of what was filed with the commission. The labeling on the doors on these cases includes the word "Valuation" in addition to the standard wording.

REPRODUCING TRACINGS

In the commission's specifications a provision is made that the maps and profiles for filing with the commission may be made "by lithographic process, approved by the commission, on the best grade of tracing cloth." This proviso has enabled the railroads to save a vast amount of money, as the lithographic processes of reproducing tracings on tracing cloth have been developed to a high degree of perfection during the past few years. Reproductions are now made true to scale and of any size, either from parts of large tracings or from a number of smaller ones which may be matched together to form a single tracing in the process. Information shown on the originals may be eliminated in the reproductions, and information not shown on the originals may be added by means of inserts. The cost of these reproductions is much less than that of making tracings by hand, and compares very favorably with the cost of making brown or black line prints on cloth.

SCHEDULES OF LANDS MADE SEPARATELY

The information required by the commission in support of the schedule of lands owned is specifically stated, and typical forms of schedules are also shown on the specimen maps made a part of the specifications. In some instances railroads have been permitted to elaborate on this form in order to have it include additional data which later would prove of value to the company as well as the commission. The form shown in Fig. 6 is more complete than that shown by the commission, and has been found to cover all desirable points which should be considered in tabulating information of this kind.

To apply this schedule to the original tracings by hand would require almost as much time and labor as the making of the maps themselves. To eliminate this extra work for the draftsmen, the schedules are worked up, by the right-of-way tabulators, on blank forms in pencil. These pencil copies are then turned over to a stenographer, who types them on a thin white transparent paper, with a sheet of carbon paper reversed

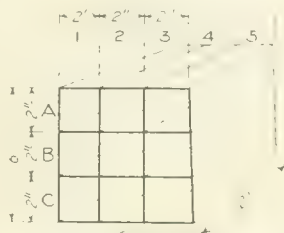


FIG. 5 — DIMENSIONS AND LABELING OF PROFILE CASE

to imprint on the back of the first sheet, three or four carbon copies being made at the same time. The sheets are numbered with the index number of the sheet of tracing to which they apply. The first sheet, from which blueprints can be made, is sent to the reproducer along with the tracings, and is reproduced on the original tracings as well as on the reproductions. The other copies are used to supply the wants of the railroad and government land appraisers.

LAND RECORDS INVALUABLE

The complete and accurate tabulation of the title to all right-of-way and real estate owned by the company is one of the greatest benefits to be derived from the valuation work. It enables the land department to locate all parcels of land the title to which may be missing or clouded, and to take steps toward obtaining clear titles. It also enables it to locate all points where trespassers are encroaching on company property, from whom the necessary rentals can be obtained or their removal secured.

To save time in the drafting room, sheets may be used by the reproducer which have the border lines printed on them beforehand, and which have been cut to the proper size—12 x 56 in. or 24 x 56 in. respectively, for profiles or maps. It has been found, however, that the saving is in time only in using these sheets, as the labor cost of ruling the borders by hand is slightly less than the additional cost of the ruled sheets. To aid the reproducer in properly placing the map on the sheets, match marks, as prescribed by the specifications, the four corners of the border lines and the valuation index number are shown on the original tracing in pencil. The proper locations for the land schedules, titles and engineer's certificates are also indicated.

At the time the reproductions are made an extra

possessed by all tracing profile cloth now on the market. For the sake of the eyes of those who work on these profiles the use of a cloth on which the plate lines are printed in green is recommended.

The specifications permit the combination of track and land maps into one for towns where extensive and complicated property is owned, and the combination can be made without sacrificing the clearness of the map. While this may be satisfactory for the purposes of valuation and the use to which the maps will be put by the commission, it is certainly undesirable from a current-record standpoint, as it requires the carrying of the land schedules on the station track map with the accompanying parcel numbers on the face of the map, and in a measure subordinates the track and structure features, the recording of which is the real purpose of the station map. Wherever a large-scale station land map is necessary to show clearly the various parcels of property, it is advisable to prepare a straight land map without tracks and file it as a part of the right-of-way records.

ORGANIZATION OF DRAFTING ROOM

The organization in the drafting room for handling the valuation work during the period of preparing maps for filing should consist of several squads, each assigned to a special branch of the work, such as detailing right-of-way maps, tracing them, tabulating right-of-way title, correcting and retracing station plates, replatting and tracing profiles and putting the finishing touches on the reproductions. The new right-of-way maps are first detailed in pencil, the work being done in conjunction with the notes taken in the field by the federal chaining parties. After the government field notes have been applied, all differences between them and the old records reconciled, and the match marks

... COUNTY OKLAHOMA VALUATION SECTION NO . . .											
Line No	Parcel No.	Custodian's No.	Sta. to Sta.	Area Acres Sq Ft	Price	Grantor	Grantee	Class of Title	Date	Recorded Book Page Date	Description
1											
2											
3											

FIG. 6—THIS FORM FOR SCHEDULE OF LAND HAS BEEN FOUND TO COVER ALL DESIRABLE POINTS

set of maps is made and turned over to the land department, thus giving that department a complete set of tracings on which a record of right-of-way owned at present, purchased or sold in the future may be maintained, and from which blueprints may be made. From the maps of the more important cities still other extra copies are made on tracing cloth for the files of the division or district engineer.

USE INK LIBERALLY

In preparing the original tracings for reproduction, the draftsmen should be instructed to use plenty of ink, making the lines and lettering perfectly opaque. This will result in a tracing that will blueprint well, a feature that is desirable and which will make excellent reproductions. Care should also be taken in the selection of profile tracing cloth to see that a cloth is used on which the plate lines are clear cut and will produce distinct plate lines on a blueprint, this being a quality not

shown for each sheet, the detail drawing is turned over to the tracing squad, which completes the tracings and checks the work of the detailers.

The government field parties do not take any alignment notes or land-line ties, and consequently it has been necessary to maintain a field party of three men to get this information on lines where insufficient data are found in the files to plat a new map. They also check the government notes where they vary to a great extent from the original maps. This party has proved a paying investment, as it has made possible the correction of many chaining errors discovered by the detailers in the government notes and has enabled the draftsmen to turn out more dependable maps than would have been possible otherwise.

The land tabulators carry on their work of compiling the ownership of property into the land schedule for the same territory as that on which the detailers and tracers are at work. The areas are figured and parcel numbers

assigned by them either on the finished detail drawing or on the finished tracing. As rapidly as the tracings and land schedules are completed, blueprints of the maps and a copy of the schedule are made and forwarded to the land attorney of the commission for his use in compiling his report on right-of-way and real estate owned. The index maps made for each valuation section are platted on printed forms, these forms showing 1296 square miles or land sections on a sheet, the required number of sheets being matched together and pasted to form continuous sheets for tracing after the line has been platted. These forms are printed by a publishing company on a scale of $\frac{1}{2}$ in. to the mile, and by their use the labor of laying out the section lines by hand is eliminated.

The profile squad and station-plat squad are engaged in either correcting the old tracings to agree with the new right-of-way maps or platting and tracing new

the drafting work. A facsimile of this report is shown in Fig. 7.

The land schedules are compiled to cover every piece of property occupied in any manner by the railroad company's facilities, either tracks, buildings or other structures owned or used by the company, the title or right to occupancy being thoroughly investigated in every instance. When turned over to the federal land attorney, these schedules are a complete record of every piece of property owned by the company or occupied by virtue of contracts, ordinances or other rights.

One of the most beneficial results of the federal valuation to the railroads will be, as shown, a complete record of the real estate, tracks, buildings and other structures owned by the railroads, and an entire set of maps and profiles drawn to uniform scales. This will be a condition that has not existed in the past on a large number of roads, and one that will constantly be appreciated

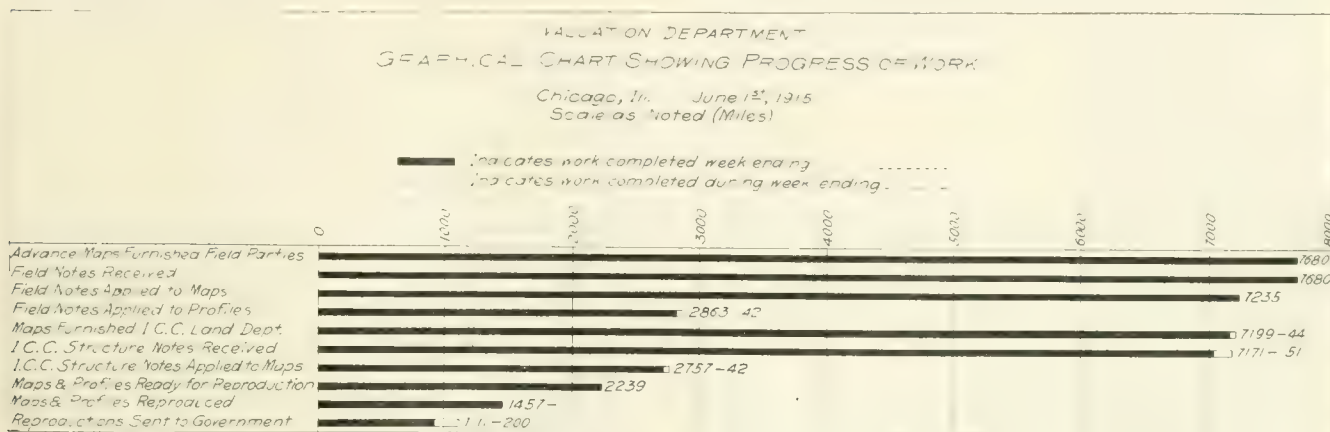


FIG. 7—GRAPHICAL REPORT SHOWS WEEKLY PROGRESS AND STATUS OF ALL BRANCHES OF DRAFTING WORK

ones. These squads have 7680 miles of profiles to trace and about 1000 station plats to redraw. A separate squad is assigned to the work of checking the tracings to see that all requirements in the specifications have been complied with before they are submitted to the government engineer for inspection and approval before reproduction, and also to touch up the reproductions before they are forwarded to the commission for filing at Washington.

All titles are printed on the reproductions and originals with a small hand-printing press, using standard styles of type and Keloe tracing-cloth ink. This method of putting on titles has proved so much more economical than handwork by the draftsmen that there is no comparison between the two methods. Titles for a complete valuation section, where the number of sheets, including maps and profiles, run as high as 200, can be applied in less than a day by one man. The work should be done by a man who has had experience in printshop work. Titles printed in this way, if allowed to dry properly, are practically as permanent as those applied by hand with India ink, and blueprint equally well. In addition they improve the appearance of a tracing very materially over the hand titles, and uniformity of titles is maintained throughout the entire set of maps.

GRAPHICAL WEEKLY REPORT

At the close of each week the valuation chief draftsman submits a graphical report showing the progress made during the week and the status of all branches of

especially in the engineering departments. To file properly these records, which have been obtained at heavy expense, is a question worthy of much study, and the system outlined will offer many advantages over various others now in use.

Illinois Sewage-Plant Operation Needs Better Attention

Winter Investigation Finds Equipment for Final Treatment Generally Out of Commission—
Local Authorities Lack Knowledge

SEWAGE sedimentation tanks receive less intelligent attention in operation than any other part of the disposal plant. This statement and the further one that the whole operation of the greater number of sewage plants recently visited under winter conditions is lamentable are conclusions expressed by M. C. Sjoblom, assistant engineer of the Illinois State Board of Health, in a paper recently presented to the Illinois Society of Engineers. Ten plants were reported on, eight of which were visited in January. In all cases the installations provide for preliminary treatment by one or two-story tanks, and final treatment through intermittent sand filters, sprinkling filters or contact beds.

Practically none of the towns visited has an organized sewer department, and the responsibility for the care of the sewerage system and sewage-treatment works falls on the village council. Two of the cities have engineers

who superintend largely the operation of the treatment works, but even here the work is apt to be hampered by financial obstacles and by having to accept such help as the councils will provide. In the majority of the towns there seemed to be a general feeling that the duties of the caretaker at a well-designed sewage-treatment plant are rather unimportant and that the plant should require only occasional attention. The operation of the plant has therefore in most cases been added to the duties of the local policeman or street commissioner, who can give it only a fraction of the time and attention necessary to obtain a proper effluent. Of the ten plants visited not more than three appeared to be properly cared for and to be giving satisfactory results in a general way, while in one of these the filter area is so limited that less than half the sewage can be given secondary treatment.

TANK TROUBLES NUMEROUS

Barrington has a combined system which affords house sewerage facilities for only a small portion of the population. The outfall sewer consists of a 10-in. inverted siphon having its invert 5 or 6 ft. below the flow line in the tanks which constitute part of the treatment works. Based on measurements made of the dry-weather sewage some time ago, the velocity of flow through the siphon is often negligible, and most of the time probably does not exceed $\frac{1}{2}$ or $\frac{3}{4}$ ft. per second. Consequently organic wastes settle out in the siphon during normal flow, only to be washed later, in a septic condition, into the screen chamber.

The screen chamber was found to be completely filled with a slimy dark sludge which all but shut out the flow into the Imhoff tank. As the Imhoff tank is installed largely for the purpose of keeping the sewage from becoming septic, the object sought is thus defeated by the sludge in the screen chamber.

MISDIRECTED ENERGY

At North Chicago the plant consists of two septic tanks, a dosing chamber, sludge bed and trickling filters. During one day per week the sewage is bypassed directly into the small creek ordinarily receiving the filter effluent, and the contents of the tanks, including the sludge which has accumulated during the remainder of the week, are slushed directly into the same stream. The cleaning of the tanks requires the services of two men for a day each week. Thus the plant does not serve the purpose for which it was installed—not through lack of attention or faulty design, but through unintelligent and misdirected energy.

The other extreme was found at Downer's Grove, where the tank has not been cleaned for more than six years, and the retention period has been reduced until the crude sewage, with its fresh suspended and floating solids, passes directly through the tank. The plant here includes a septic tank, a dosing chamber and several small trickling filter units; but owing to the freezing of the dosing apparatus, which is rather complex in construction, only the tank is now in operation, and the crude sewage is discharged directly into the small creek which ordinarily receives the filtered effluent.

In all three of the towns where two-story tanks comprise a part of the treatment works it was found that large quantities of scum are permitted to accumulate in

the sedimentation channels. At Olney this trouble arose from the fact that the plant is not provided with a means for the removal of sludge, and the authorities, through lack of knowledge as to the principles of operation, had permitted the sludge to accumulate until it filled the tank above the slots. The sedimentation channels acted therefore as poorly arranged septic tanks.

The dosing apparatus in practically all the plants appears to cause the attendants the greatest amount of trouble and worry. This apparatus, though supposed to operate automatically, needs daily attention, as there is no warning given when a siphon is going to lay off, and if not attended to regularly the flooding of some of the filter units occurs. Almost every plant attendant interviewed told of difficulties experienced in learning to remedy siphon disorders.

MOST FILTERS QUIT IN WINTER

None of the intermittent sand filters in the towns visited recently was in operation, on account of the cold weather, and only one of the plants, including trickling filters or contact beds—namely, that at LaGrange—was operating to give satisfactory treatment to all of the sewage. At Chicago Heights the contact beds are probably operated as efficiently as possible under existing conditions, but owing to their limited area and the inadequate size of the dosing apparatus, which cannot handle all of the sewage, at least half of the sewage is passed directly from the septic tank to a nearby creek which receives the filter effluents.

At North Chicago only a portion of the filter area was in use, as one of the dosing siphons was out of repair. At the Naval Training Station the trickling filters were completely submerged, due to the sewage in the effluent troughs being frozen. At Fort Sheridan the nozzles on several of the risers in the sprinkling filters were missing, thus permitting practically the entire flow of sewage through the few uncovered risers and little, if any, through most of the nozzles. At Downer's Grove the trickling filters were out of commission, on account of the freezing of the dosing apparatus, while at Pana only about half of the distributing troughs over the trickling filters were receiving sewage. In several instances, said Mr. Sjoblom, little if any better results are being accomplished than would be possible with a sedimentation tank alone, if intelligently operated.

WHO IS TO BLAME?

The entire blame for the deplorable state of affairs probably cannot be laid to any one person or department, Mr. Sjoblom thinks. It appears, however, that those chiefly to blame are the municipal authorities who, through the desire to keep down expenses, or more often through ignorance, simply instruct the policeman or street commissioner to care for the plant and then apparently feel that the responsibility has been removed from their shoulders. In a majority of these cases the officials seldom if ever visit the plants, and when complaints are made regarding nuisances often fall back on the statement that their plant is one of the most complete in the neighborhood and that they understood the plant was operating splendidly only a short time before.

To what extent the engineer is to blame for this state of affairs is difficult to judge. If one is willing to take the word of some city officials or plant attendants, how-

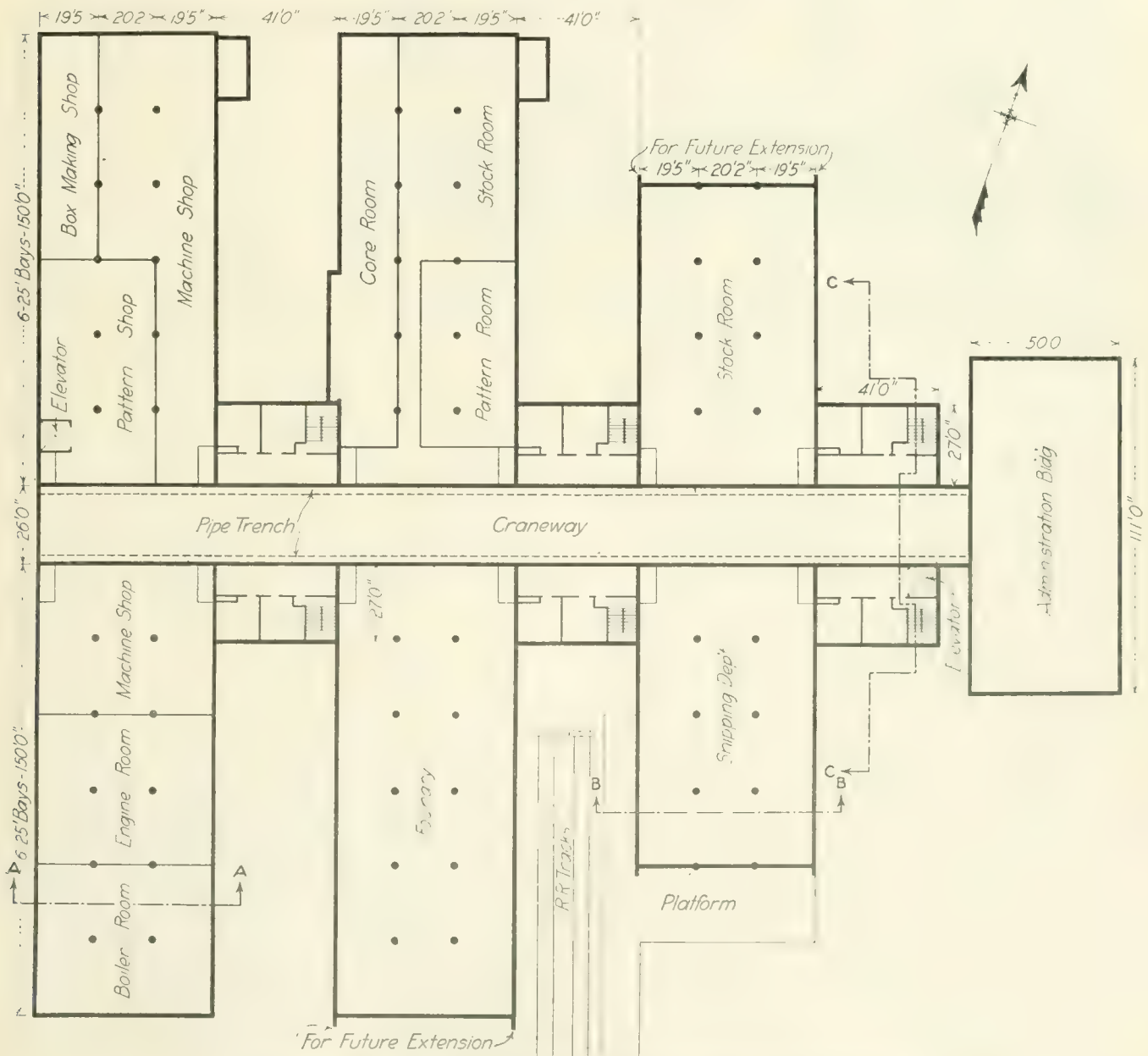
ever, it appears that quite often the engineer has given few if any instructions as to the importance of careful supervision, and it is not strange that results have not been wholly satisfactory.

Where faithful and conscientious attendants are maintained they often give their work considerable attention and the plants are operated quite efficiently. As this state of affairs is the exception to the rule, however, it appears to Mr. Sjoblom that some means should be devised which would provide for the intelligent operation of all plants installed. To this end it was suggested that the city officials in engaging an engineer to design sewage-treatment works should also retain him to take charge of its operation for a year or more. In this way some man in the community could be trained in the duties connected with the plant. Another plan which might be practical consists in having the communities employ some competent engineer to make occasional visits to their respective plants and to see that the plants are being properly operated.

Factory Building Has Central Crane-way with Lateral Wings

Manufacturing Plant in Flushing, N. Y., Planned for Efficient Handling of Materials—Modern Administrative Facilities Are Provided

ONE of the most unusual layouts for a factory building yet used in this country is the type adopted for the new plant of the Nathan Manufacturing Company on Flushing Creek, Flushing, within the limits of New York City. Following a plan used for the Siemens-Halske factory in Berlin, Germany, a central craneway with lateral wings on each side makes the efficient handling of materials and central control a matter of great simplicity. This layout can be compared with the H-plan for the Sun Shipbuilding Company, described in the Engineering Record of Oct. 21, page 498. At the end of the craneway and directly connected with it is the administration building, containing every mod-



GENERAL PLAN—FIRST FLOOR OF FACTORY AND ADMINISTRATION BUILDING

ern convenience for the welfare of the employees, including rest rooms, dining rooms, roof gardens, etc.

MARSH LAND REQUIRES PILE SUPPORT

The location of this factory on marshy lowlands near tidewater made the foundation and construction work unusually difficult. Materials could not be stored or moved over the site without special timber platforms, walkways or roadways, hence a single central concreting plant and tower were required. Piles, ranging generally from 30 to 60 ft. long, were necessary in every case where loads were supported, even for the light pipe

cover these with 12 in. of plain concrete, and cast the reinforced concrete upon this as a base. A cinder fill averaging about 3 ft. deep is being spread over the entire site.

The property is located on Flushing Creek near the Long Island Railroad, between Amity and West Grove streets, with the administration building facing on Lawrence Street. The administration building, 50 x 110 ft. in plan, is connected to the central craneway, which is 26 ft. wide and 312 ft. long, by inclosed passageways 11 ft. long. The craneway is 15 ft. higher than the factory buildings, with the entire roof glazed and a row

of sash in both walls above the factory roofs, giving exceptional light. On each side of the craneway are three wings running north and south, nearly 60 ft. wide, two 150 ft. long and one 100 ft. long, as noted in the first-floor plan here reproduced. Between the wings are spaces or courts 41 ft. wide, which insure ample daylight for these two-story parts of the factory. At the intersection of the craneway and these courts are six short extensions in which are located locker rooms, toilets and stairways.

The advantage of the layout adopted lies in simplicity of supervision and in the ease of handling materials by the crane in the central artery of travel, where the raw materials and the various products in different stages can be

shifted from floor to floor or from one side to the other. Cost-keeping becomes an exact science, inasmuch as the individual processes may be isolated, although the finished product is completed under one roof.

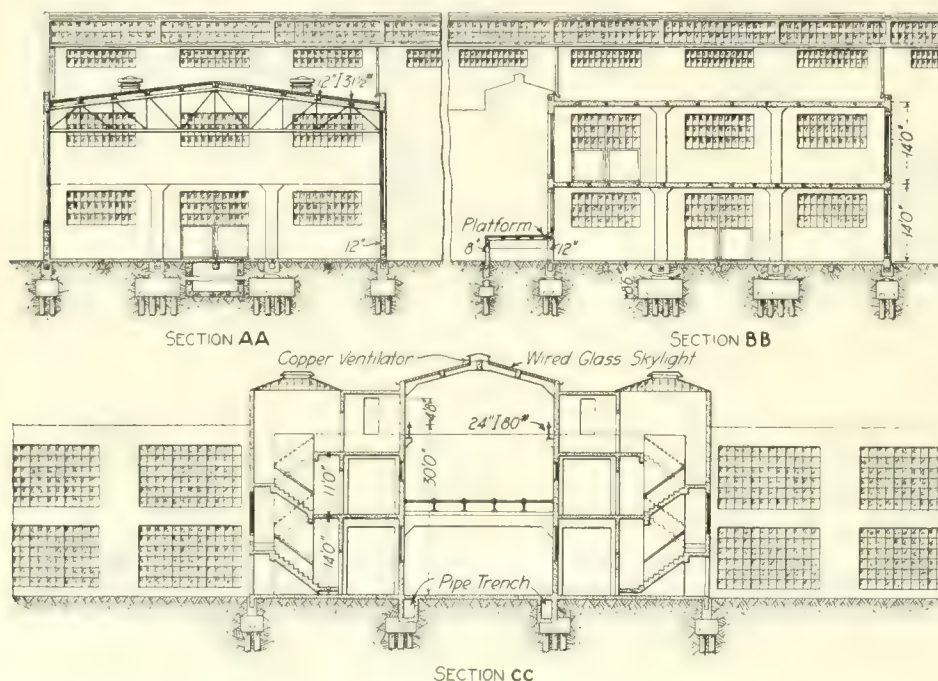
The location of the different fabricating shops, etc., is indicated on the first-floor plan. The upper floors are used for machine shops, toolroom, blacksmith shop, assembling room, testing, drafting, accounting and research departments.

MATERIALS DELIVERED BY WATER

Materials are delivered by water on Flushing Creek, about 300 ft. west of the factory building, by the siding shown, which connects with the Long Island Railroad, or by auto trucks. A one-story building, 40 x 150 ft., is located at the waterfront, to be used for a storehouse, pump room and tank room. This building, like the main factory buildings, has reinforced-concrete walls and a composition roof carried by concrete slabs on steel trusses.

A short distance to the south of the main factory, located near the boundary of the property, is the garage to house the auto trucks used by the company—a building 52 x 123 ft. in plan and two stories high, built of reinforced concrete.

Modern facilities for the comfort and welfare of the employees are embodied in the layout of the administra-



SECTIONS LOCATED BY PLAN ON PRECEDING PAGE SHOW DETAILS OF ARRANGEMENT

lines crossing the property. Another special feature in this plant is the combination of steel roof trusses for the 59-ft. spans in the foundry and in the boiler and engine rooms with reinforced-concrete columns, which at the present prices of steel and with a concrete plant working on the site were found to be economical.

FOUNDATION DIFFICULTIES

Practically the whole of the 15-acre property is a treacherous marshy soil, consisting generally of about 4 to 5 ft. of peaty material above a soppy clayey silt. The silt is so wet and loose that in the transmission of pressure it acts as a fluid. The pressure increases and diminishes with the rise and fall of the tide, and varies to such an extent that the 18-in. bottom of a reinforced-concrete pump pit laid at low tide and allowed to set for a few days under water (the pit was filled to counteract the upward tidal pressure) cracked at high tide after the water was pumped out. In this saturated soil more than 6000 piles 30 to 60 ft. long were driven for all foundations for walls, columns, conduits, etc., and in many cases an exceptionally large number of such piles were driven to prevent future settlement.

Another difficulty in the laying of foundations was encountered in the fact that the muddy soil would not even support the concrete for capping the pile heads. It was found necessary to tamp in a 1-ft. layer of cinders,

tion building. The main entrance, with bronze-covered doors, leads to a central lobby and stair hall extending through the building in line with the craneway, or central artery of the factory proper. Offices, selling room, toilets, etc., occupy the greater part of the three-story structure except the third floor, where rest rooms and a large dining room, with a roof garden on each side, make the building distinctive as an especially well-designed structure for its purpose.

Above the main dining room is a tank room for housing a 45,000-gal. tank. Passageways at each floor connect with the craneway of the main factory buildings. A complete view of the factory operations will be obtained from balconies in the central craneway. In this craneway at the second-floor level are three passageways of full-panel width, connecting the wings on the two sides and the administration building. Material is transferred from floor to floor and from one wing to another by the 2 and 6-ton cranes carried by I-beams on the reinforced-concrete wall brackets shown in one of the cross-sections.

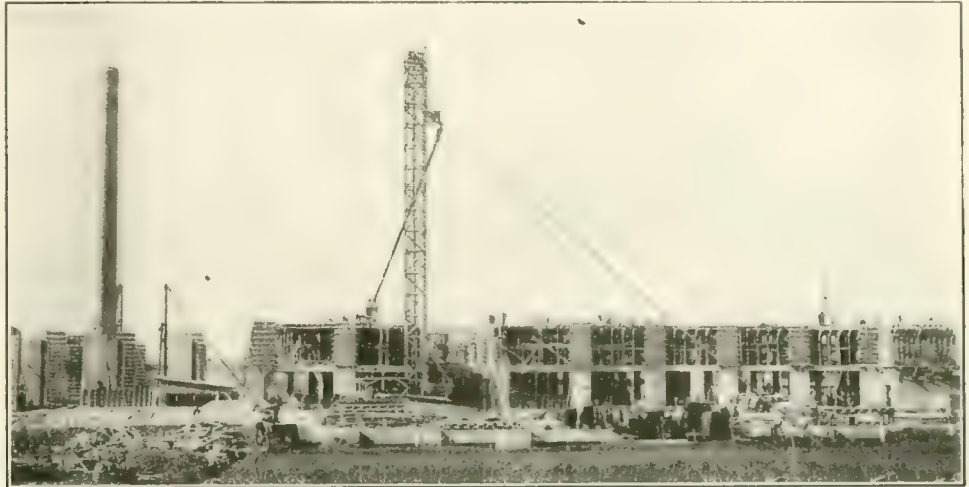
Instead of using steel columns to support the steel roof trusses of two wings in the southwest corner, reinforced-concrete columns or pilasters were adopted for economy, owing to present high prices and slow deliveries for structural steel, and because the concrete plant and full equipment were on hand for concreting these columns economically.

CONSTRUCTION FROM CENTRAL TOWER

In view of the unfavorable conditions of the ground, and the consequent necessity for special timber platforms and passageways for storing and moving the concrete materials, it was necessary to adopt a single central concrete plant with a tower 130 ft. high located near the craneway, using long chutes to the various parts of the main buildings. As seen in one of the photographs, this tower was located as near the center of the group as possible without interfering with the erection of the craneway walls. The scheme worked

very successfully. After the slow and difficult work on the foundations was completed in the latter part of August, 1916, up to Jan. 6, 1917, 20,000 cu. yd. of concrete was placed with the single central plant and two small movable mixers. The total yardage for the plant will amount to 27,500 cu. yd.

The Nathan Manufacturing Company is spending approximately \$750,000 on this plant, not including the cost of land. It has filled in the open sewer originally crossing the site and provided a closed diverting sewer across its property to connect to the Amity Street sewer. After placing the cinder fill it is expected to

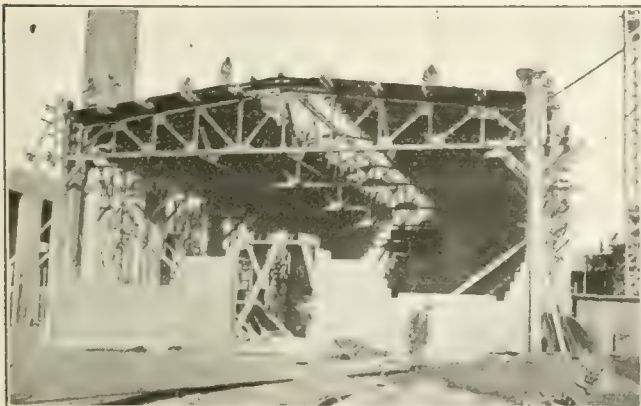


SINGLE CONCRETING TOWER SERVES ENTIRE CONSTRUCTION ON MARSHY GROUND
Columns on left will support roof trusses of foundry building. Craneway is on right of tower.

plant grass and shrubs to make attractive surroundings for the workers. The plant will manufacture locomotive injectors and fittings. It was designed by Eugene Schoen, architect, and the construction is being carried on by Rheinstein & Haas, Inc., of New York City, the general contractor.

Defines Duties of Reclamation Service Officials in Denver Office

As there has been some misconception of the duties and responsibilities of the officials in the Denver office of the U. S. Reclamation Service, and some of the project managers have failed to realize that they are in sole and responsible charge of all administrative and engineering work under their respective projects, the January *Reclamation Record* gives the duties of the various men in the Denver office. Of the chief of construction it states that he represents the director and chief engineer in the field and is in charge of all matters relating to the management and execution of the work in the field and all employees engaged in the construction, operation and maintenance of the projects and works incident thereto. All instructions issued from the office of the chief of construction on administrative and engineering matters relating to the management and execution of the work in the field are issued over the signature of the chief of construction or his assistant. Project managers are in sole and responsible charge of all work on their respective projects and such territory contiguous thereto as may be assigned by the chief of construction.



CONCRETE WALLS AND STEEL ROOF TRUSSES IN WINGS

Proposes to Build High-Level Bridge Over Hudson Ten Miles South of Albany

New York Central Plans Extensive Connecting Railroad and Mammoth Yard to Avoid Albany Dip, Drawbridge and Pusher Grade

IT IS EXPECTED that the U. S. War Department will grant a permit to build a high bridge over the Hudson River, 10 miles south of Albany, thus removing the last obstacle to the construction of the Hudson River Connecting Railroad. The Hudson River Connecting Railroad is probably the most important single project undertaken by the New York Central Railroad in twenty-five years, with the exception of the Grand Central Terminal reconstruction and the electrification of the terminal zone, and is expected to effect a great saving in the operation of the New York and Boston stems of the New York Central system. The improvement, which is primarily designed for freight service, involves a high-level connection from the Boston & Albany Railroad and an easy approach from the Hudson division of the New York Central on the east bank of the Hudson River to the West Shore Railroad on the opposite bank. It also involves a mammoth freight yard. It will avoid the pusher grade out of Albany for westbound freight traffic and the dip for all Boston & Albany freight business in both directions. It will also remedy the drawbridge congestion at Albany and the inadequacy of the West Albany yard, which cannot well be expanded.

PRESENT OPERATING CONDITIONS AT ALBANY

The wide scope of the project will be made clear by the accompanying railroad map of the vicinity of Albany. Westbound the New York Central follows the Hudson River north on easy grades from New York to Albany. It then turns westward and makes a 4-mile ascent of West Albany hill, partly on a 1.7-per cent grade, necessitating pusher engines. On the brow of this hill, partly on the grade, is the West Albany freight yard, which serves both the New York Central and the Boston & Albany. Though this is a large hump yard, it has been outgrown by the business and the site is not suitable for expansion. Continuing westbound to Schenectady, the line descends on a 0.75-per cent grade. The summit is 80 ft. above Schenectady and 303 ft. above Albany. West of Schenectady the road proceeds along the north bank of the Mohawk River.

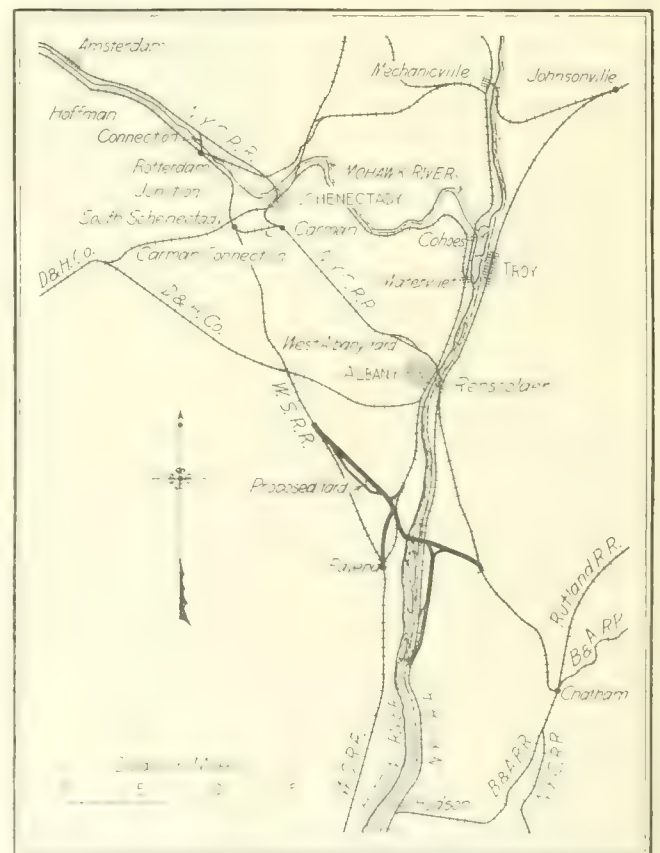
Eastbound from Albany the Boston & Albany leaves the New York Central at Rensselaer, just across the Hudson River from Albany, and runs south along the hillside, ascending on an average grade of about 1 per cent and gradually working away from the river. At Brookview, however, 8 miles south of Albany, the line is less than 2 miles from the river, while at Chatham, 23 miles from Albany, it is only 9 miles away. At Chatham it turns eastward.

Both the New York Central and the Boston & Albany cross the Hudson River at Albany on two double-track drawbridges, one for passenger business, the other for freight. The handling of the great volume of traffic over these drawbridges naturally causes congestion

and creates many operating problems resulting from the delay to traffic by the opening of the drawbridges for the passage of vessels during the season of navigation. These troubles will be relieved by moving the freight via the Hudson River Connecting Railroad, avoiding Albany and crossing the Hudson River on a high-level fixed bridge instead of the drawbridge.

WEST SHORE RAILROAD AS AN AUXILIARY

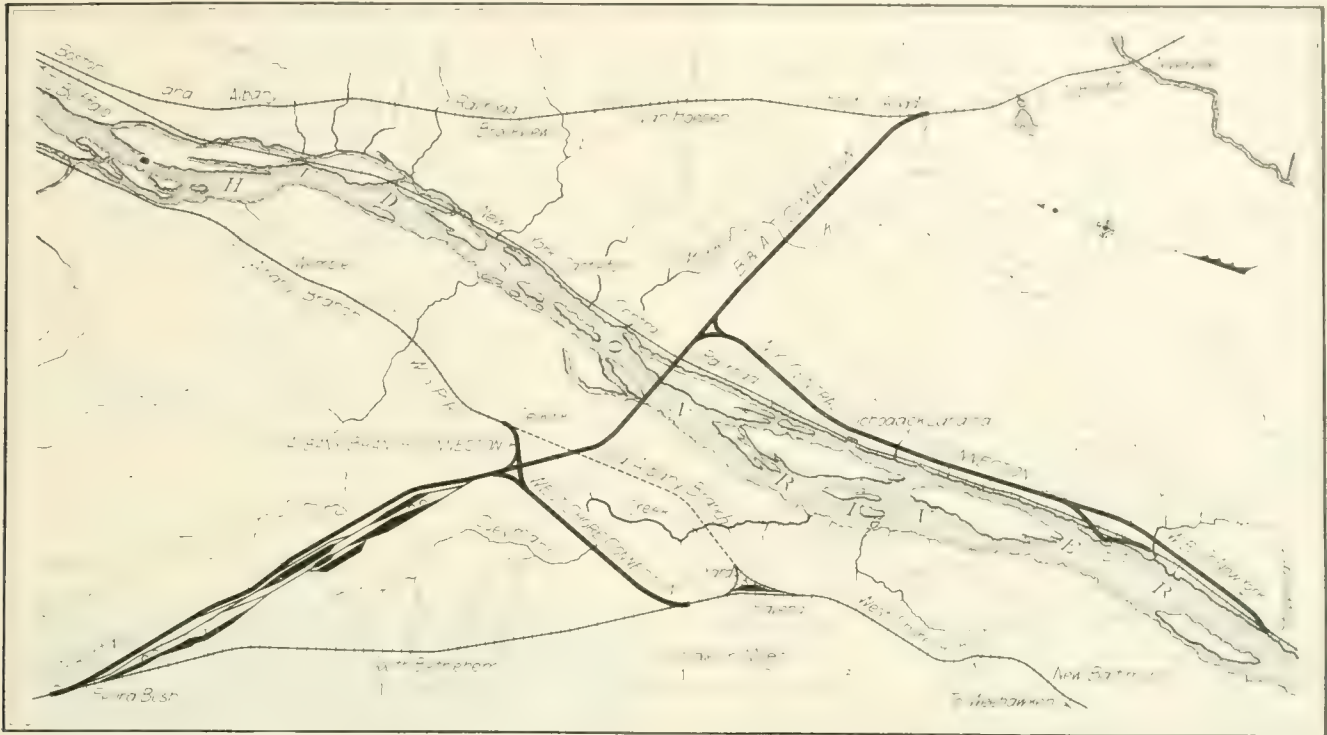
The West Shore Railroad was built in the '80s as a parallel competitor of the New York Central, following the west bank of the Hudson River and the south bank of the Mohawk River. It avoids the sharp ascent at Albany by beginning the climb well down the Hudson River and passing over the brow of the hill 8 miles



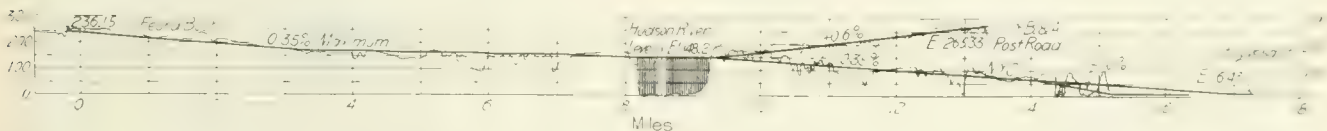
RELATION OF PROPOSED CONNECTION TO RAILROAD MAP OF ALBANY AND VICINITY

southwest of Albany. It then runs around Schenectady, avoiding the heavy eastbound ascending grade there. A branch of the West Shore runs from Rensselaer, where there is a division yard, to Albany.

The New York Central has long had control of the West Shore, using it for the movement of considerable freight, which is thereby kept out of the way of the New York Central main line's heavy passenger traffic. The grades of the West Shore between Buffalo and



PROPOSED CONNECTION WILL UTILIZE WEST SHORE TO REDUCE GRADES AND AVOID CONDITIONS AT ALBANY



PROFILES OF NEW YORK CENTRAL AND BOSTON & ALBANY CONNECTIONS WILL CONFORM TO RULING GRADES OF THOSE STEMS

South Schenectady have been reduced to expedite the handling of this freight. A great part of the New York Central's eastbound through freight, for instance, is moved via the West Shore from Buffalo to South Schenectady, there crossing over to Carman on the main line of the New York Central, thence via the West Albany yard and the Albany drawbridge.

There are other crossings connecting the New York Central and the West Shore at various points between South Schenectady and Buffalo, providing flexible operation of the two systems. There being no connection east of South Schenectady and Carman, however, it is necessary to move all freight between the west and New York and Boston through the West Albany yard and grade and the congested drawbridge. New York freight can, of course, continue down the West Shore to the Weehawken terminal opposite New York, but this necessitates ferrying across the North River. The handling of freight via the Boston & Albany is further hampered by the heavy grades between Albany and Chatham. These difficulties will also be minimized by the proposed high-level connection and the diversion of traffic around Albany.

FIRST STUDIES MADE IN 1902

As early as 1902 studies were made with a view to overcoming some of the disadvantages at Albany. The first studies contemplated a high-level bridge over the Hudson at that point, the line swinging around to the Boston & Albany first, then continuing down to the New York Central south of Rensselaer. This plan, however, would not have solved the problem of the

West Albany yard. Later the possibilities of a mammoth classification yard on the plateau traversed by the West Shore south of Albany were perceived. Several possible sites for a high-level bridge were investigated and numerous studies were made. The final choice is shown by the large plan.

DETAILS NOT YET WORKED OUT

Most of the details are yet to be worked out. As now planned, the connection will leave the Boston & Albany at Post Road, $1\frac{1}{2}$ miles north of Niverville and about $4\frac{1}{2}$ miles east of the Hudson. It will cross the river practically at right angles. Except for a slight swing just east of the New York Central junction, the line will be straight from the Boston & Albany across the river. The westbound New York Central connection will begin the ascent from the main line at Stuyvesant, 8 miles below the high bridge; to avoid a grade junction, the eastbound connection will cross over the main line and join it $1\frac{1}{2}$ miles north of Stuyvesant. West of the Hudson River bridge the line will pass over the relocated Albany branch of the West Shore, the present Albany branch being abandoned between Selkirk and Ravena. Beyond this the proposed freight yard will extend 5 miles to the junction with the main line of the West Shore at Feura Bush.

Profiles are shown of the various lines. The Boston & Albany connection will leave that road at El. 265.33 and descend on practically a uniform 0.6-per cent grade to the level of the bridge, El. 148.2. The westbound New York Central connection will have a uniform ascending grade of 0.35 per cent, compensated. The

lower end of the eastbound connection will be on a 1-per cent grade. West of the bridge the ground slopes gently upward and the profile can easily be kept to the ruling grade of 0.35 per cent.

A YARD LARGER THAN GARDENVILLE

Studies are being made for a yard at Feura Bush that will rival the one being built by the company at Gardenville, near Buffalo. Nothing is determined as yet, but it is probable that the yard will have five humps and that its capacity will be 23,000 cars. The layout can be made to fit the ground closely.

The details of the bridge depend on the decision of the War Department in the matter of spans, but it must clear high water by 135 ft. The plan submitted by the railroad contemplates a 600-ft. span over the government channel and an auxiliary 405-ft. span immediately to the east thereof. There will probably be a long viaduct approach at the east end and a shorter one at the west, the probable total length of the bridge being about 5100 ft.

On the main connections the sharpest curve will be 2 deg. 30 min. On the less important connections there will be one or two 6-deg. curves. There will be no highway grade crossings. Probably three highways will have to be carried over the Feura Bush yard. Various other highways will be carried over or under.

Considering the magnitude of the project, the amount of grading will be small, as the various lines have been so located as to follow the ground closely at most points. The largest cut will be at the junction of the New York Central and Boston & Albany connections, where about 800,000 cu. yd. will have to be taken out, all of which can be used to advantage in embankment.

SAVING IN DISTANCE

With the completion of the improvement the Feura Bush yard will be the division point for New York Central, West Shore and Boston & Albany freight. Besides avoiding the Albany drawbridge, the West Albany yard and the grade difficulties, the proposed connection will save the New York Central 4.5 miles and the Boston & Albany 2.7 miles in distance.

The plans to date have been developed under the direction of G. W. Kittredge, chief engineer, and J. W. Pfau, engineer of construction. B. C. Martin has within the last few months been appointed district engineer to take immediate charge of the construction. H. T. Welty, engineer of structures, will have charge of the design of the Hudson River bridge, while G. P. Stowitts, designing engineer, will direct the design of the Feura Bush yard.

Massachusetts Road Expenses Increase

Expenditures for road improvements increased 205 per cent in Massachusetts in 1914 over expenditures ten years ago, according to road statistics made public recently by the U. S. Department of Agriculture. The State spent more than \$6,000,000, giving her a percentage of 45.53 surfaced roads. Approximate expenditures for the other New England States were: Connecticut, \$3,640,000; Maine, \$2,642,000; New Hampshire, \$1,590,000; Vermont, \$1,024,000, and Rhode Island, \$446,500.

Waterproof Box Built Around Expansion Rollers

Riverside Drive Viaduct Repainted and Repaired—
White Lead and Tallow Applied to
Rollers After Cleaning

THE PRELIMINARY inspection of a viaduct, about 40 ft. high, which carries Riverside Drive in New York City over the New York Central tracks between West 153d Street and West 155th Street, revealed that the paint on the steelwork had deteriorated to such an extent that approximately 5 per cent of the metallic area exhibited deep pits and scales; also the expansion roller nests, which were unprotected from the elements, had become badly rusted. Under an appropriation from the city for repainting and repairs the entire structure was chipped clean, painted and specially designed housings were provided for each of the thirty-three roller expansion bearings, to keep out



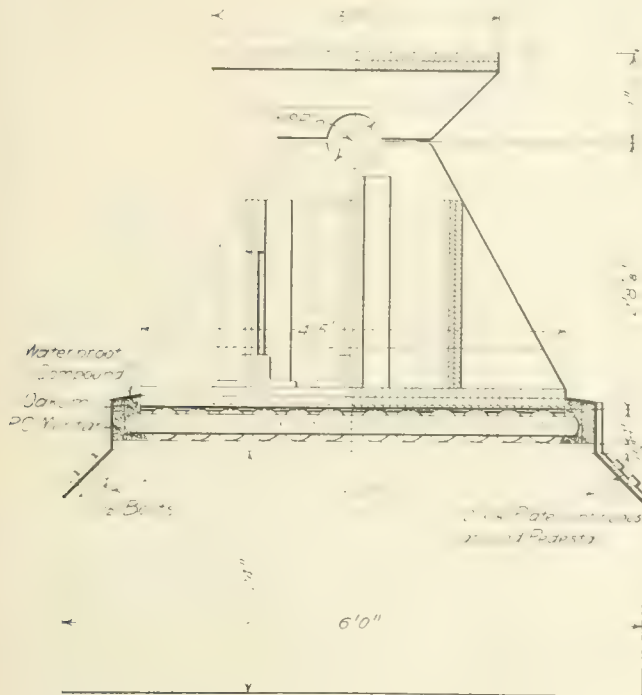
ROLLER NESTS ARE OILED, SEALED AND WATERPROOFED

the water and protect from dirt and rust. The details of this housing are here illustrated.

The steel cantilever structure, erected in 1908, is 680 ft. long and contains thirty-three plate-girder floorbeams, 10 ft. deep, with a maximum length of 97 ft. for twenty-five girders and varying lengths for the eight girders at the curving southerly end, as shown in one of the photographs. The overhang of the main girders is 49 ft. and the anchor span is 46 ft. 6 in., resulting in possible uplift at the inner ends, for which anchorage is provided.

The expansion detail was designed with 7-in. pin bearings in built-up shoes with sole plates about 4 ft. square resting upon a roller nest of twelve 4-in. rollers. The base plates, 5 ft. square, rest directly upon granite pedestals on the western of the two parallel concrete and granite walls of the substructure.

The computed horizontal movement of the roller for a variation of 100 deg. Fahr. is $\frac{3}{8}$ in. It was considered necessary that these rollers should be protected from rust and properly lubricated in order to



DETAILS OF METHOD USED TO SEAL ROLLER NESTS

prevent the development of temperature stresses. This was accomplished as follows:

HOUSING THE ROLLER NESTS

All the side bars were removed from the roller nests and the rollers cleaned of rust and scale by scouring with steel wool and the use of an air blast. An application of white lead and tallow to all the rollers and bed plates followed. As indicated on the drawing, 12x $\frac{1}{4}$ -in. steel plates 5 ft. 2 in. long were then bent longitudinally to allow one leg to be bolted to the bevel face of the granite pedestal by $\frac{1}{2}$ -in. bolts, while the other leg is vertical. When spliced at the corners, these plates formed a square metal box open at the top. Before bolting them to the masonry, they were heated and molten waterproof cement was applied between them and the granite and to the corner joints.

The inside of this box was then lined with Portland-

cement mortar up to within $1\frac{1}{2}$ in. of the rollers, the space was packed with oakum and the whole sealed on the top with waterproof elastic cement applied in a molten state. In this way a complete housing is formed around the rollers which permits of free movement and yet excludes water, dust, débris, etc. It also prevents the corrosion from water of condensation because it excludes circulating atmospheric air, and at the same time, by the removal of a small portion of the oakum, will permit ready access for examination or lubrication.

In fastening the $\frac{1}{8}$ -in. plates to the granite pedestals it was noted that several of the roller bed plates had been originally set out of line, and it was necessary to trim them with the oxyacetylene burner in order to place the housing symmetrically. It was also necessary to drill the granite for fastening the $1\frac{1}{4}$ -in. bed plates, as no bolts had been placed in the anchor holes of the bed plates.

The work was done, at the request of the park commissioner, under the supervision of the Department of Plant and Structures of New York City, of which F. J. H. Kracke is commissioner; E. A. Byrne, acting chief engineer; and A. LaForge, resident engineer.

Large Vessels Built of Reinforced Concrete in Norway

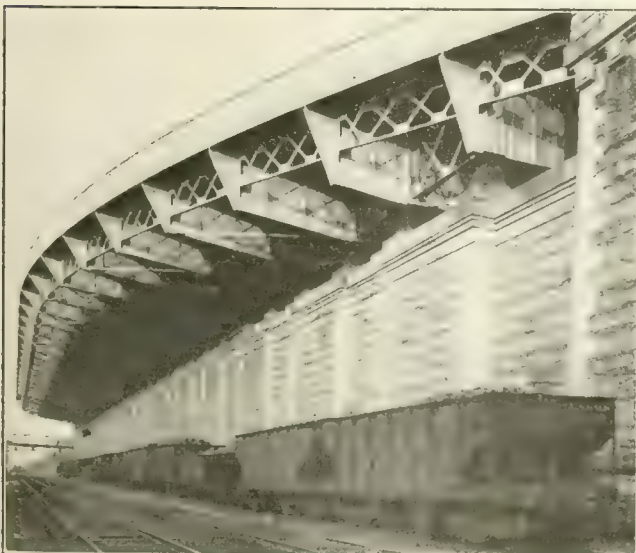
Lighters Resembling Huge Barges Are Being Constructed of Concrete on Steel Ribs—Slip Ready for 4000-Ton Craft

A RECENT letter from the American consul-general at Christiania describes the application of reinforced concrete at a plant in Moss, Norway, to the construction of vessels of relatively large displacement—up to 3000 tons. The following quotations from this letter indicate the extent of the new development in the concrete field in Norway:

"The inventor of this new style of vessel is said to be M. Nicolai Fougner, an engineer, who claims to be able to construct a ship of any size demanded. He is now building a lighter for a mining company at Sydvaranger for the oversea export of iron ore and the import of coal. The vessel, having a displacement of 3000 tons, is to be ready before the end of the current year. It is stated that these concrete ships can be sailed or engined like other vessels, and experts consider that a new epoch in shipbuilding has arrived.

"The ship, which arrived in Christiania last month, resembles a large barge, and is constructed entirely of concrete with the exception of the ribs, which are of steel. This new method of constructing ships has attracted much attention. The Swedish Minister of Marine, M. Brostrom, one of Sweden's largest ship-owners, immediately ordered a lighter of some thousand tons displacement, and he was present when the craft was launched at Moss. He was accompanied by four experts, all of whom expressed much satisfaction at the result.

"Two other lighters are now on the stocks, and a large slip for a 4000-ton craft is nearly completed. More than 200 men are now working in the new yards, and five lighters have been contracted for in addition to the one completed and the two on the slips."



EXPANSION ENDS OF CANTILEVER GIRDERS SUPPORTING RIVERSIDE DRIVE

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Largest Floating Drydock

SIR: In your issue of Jan. 20, page 123, you print a photograph and give a description of a floating drydock. You do not say so unqualifiedly, but the inference is that the drydock described is the largest in existence.

When giving this description we think the writer must have either overlooked or not known of the floating drydock Connaught located at Montreal. This floating drydock is, I believe, owned by Canadian Vickers, Ltd., and if my recollection serves me correctly it is 600 ft. long and has a maximum lifting capacity of 25,000 tons.

If the figures I mention are correct, the floating drydock Connaught is twice as large as the one described in your issue of Jan. 20.

Montreal.

M. BEATTY & SONS, LTD.,
G. W. DAY, Sales Manager.

Water the Chief Factor in Making Concrete

SIR: The article by Mr. Johnson, on page 790 of the issue of Dec. 30, 1916, goes straight to the root of all laitance trouble and merits careful consideration by all engineers and contractors engaged on concrete work. One engineer has said that if water cost \$5 a barrel we would get much better concrete.

Any laitance formed on concrete which will just flow slowly through chutes with a slope of 3 to 1 in a constant stream should be removed readily with wire brushes a few hours after setting. At the start it will require an engineer and two inspectors, one at the mixer and one in the forms, to obtain this result, but it has been the writer's experience that once the contractor becomes accustomed to handling this "plastic" concrete he will be perfectly satisfied, as it is surprisingly mobile in the forms and flows a considerable distance without shoveling and with absolutely no segregation. At the top of a 10-ft. lift the workmen will stand only ankle-deep and no water will show on top.

The chutes furnished by any of the leading manufacturers will take care of the output of a $\frac{3}{4}$ -yard mixer running 45 batches per hour. The main factor in the operation of a chuting system is the operator at the tower hopper. If the concrete is fed in a steady stream without a break between batches and there are no flat spots in the line of chutes no trouble will be experienced with a plastic concrete on 3 to 1 slopes. A batch of mortar should always be sent through the chutes at the beginning of a run to act as a lubricant.

Toronto, Canada.

JOHN W. RYCKMAN,
Department of Works.

SIR: I have carefully read the article on page 790 of the issue of Dec. 30, 1916, by Nathan C. Johnson, on "Water the Chief Factor in the Making of Good Concrete," and have come to the conclusion that Mr. John-

son has missed both the reason and the remedy in dealing with the subject of laitance. That laitance or cement cream exists and that it is harmful if allowed to remain in place in concrete masonry cannot be denied, but it is a far cry from the admission of these facts to acquiescence in a method of procedure that would treat this laitance as a useless byproduct that can with impunity be wasted.

Touching first on Mr. Johnson's last recommendation, I fail to see how this could possibly be put into practice. To allow the top materials to flow out of the forms and be wasted entails more difficulties than appear at first reading. In the first place, concrete that is not very fluid will not flow in this manner—the surface would have to be scraped or swept, which could scarcely be done inside of partly filled forms. Even for a very wet, liquid concrete, once settled in the forms, the surface material would not freely flow off. The laitance is often only a small fraction of an inch in depth, usually just a film. Would several inches of concrete be wasted just to skim off this little cream? Such waste would be intolerable.

It is true that under some conditions a thick layer of this laitance gathers. To waste this would be an economic blunder. If this slime or laitance were a waste byproduct like the froth on certain glasses of liquid refreshment, practical and economic means would doubtless be found of getting rid of it, and it could be wasted with impunity. But this material is the real cement itself—the only part of Portland cement that has any real cementing value. Hundreds of thousands of dollars are spent to produce this by processes that turn out finely ground cement. If this so-called slime could all be extracted from cement, there would be nothing left but a finely broken-up, inert clinker of no value whatever as a cementing material.

Mr. Johnson advocates the wasting of this valuable material in a paper that does not even hint at the one true method of preventing its segregation and conserving it for the purpose of performing a function that no other material can perform. The method to which I refer is thorough mixing. I fail to see that excess water is the bugbear that Mr. Johnson makes it out to be, and I think it would be a step backward even to approach the old method of making mealy concrete and tamping it in place. The concrete specified 15 or 20 years ago was so porous that water would flow readily through 30 ft. of it. Wet, poured concrete will hold back water under pressure in thicknesses of an inch or two.

Mr. Johnson makes much of the supposed fact that for every \$100,000 worth of concrete \$17,000 to \$40,000 is paid for holes. What of it? If this were true, it would mean a saving. Concrete is paid for in materials and the more space these materials occupy the less the concrete will cost. If the waterproof qualities and the strength are not affected by minute pores,

these pores cannot be said to be harmful. One is not cheated when he buys a sponge, even though the great portion of his purchase is air. Pores do not mean permeability of necessity. Cork is an example of this. But mealy concrete is both porous and permeable. It is like the sponge. Good wet-flowed concrete is somewhat porous, but it seems to resemble cork in that the pores do not form continuous free passages for water.

Increase in the amount of water in the concrete mix has been taken advantage of by unscrupulous and ignorant contractors by reducing the time of mixing, and this is the crux of the matter. A wet combination may appear to be well mixed when in fact it has been turned over only once or twice, whereas a dry combination does not so readily deceive the eye. It is common to see a batch mixer turned for only 30 seconds for each batch. The Joint Committee, in its latest report, wisely requires that the minimum time of mixing be $1\frac{1}{2}$ minutes. If the bulk of concrete work were mixed three times as long as it is customary to mix it, vastly better concrete would be turned out.

A paper by the writer published in the Engineering Record Oct. 16, 1909, page 435, entitled "The Nature of Portland Cement," demonstrated that the setting of Portland cement is merely the hardening of a colloid, and what crystallization takes place is incidental and of no consequence. It was shown that this so-called slime, this cream of cement, this laitance, is in reality the colloid, the active part of the cement. The rest is merely inert, broken-up clinker. If the colloid is lost, the cement is useless and the concrete will be rotten. My paper pointed out that thorough mixing is the remedy to avoid this loss.

Another problem mentioned by Mr. Johnson is the bonding of new concrete to old. The solution of this problem is often up to some one who had nothing to do with the placing of the old concrete and who could not go back and adopt Mr. Johnson's wasting method. Thorough mixing of the newly laid concrete is the best possible precaution to insure adhesion to the old surface, and picking or scraping of the latter is usually a necessity.

In the case of laying a finish coat over a base some time after the base has been poured, the best time to remove the laitance is after the base has had some set; that is, half a day or so. It is well known that concrete very soon settles into place and loses its tendency to flow, hence after the half hour recommended by Mr. Johnson the top material would not flow off. After the concrete has had time to set, the laitance may be removed by flushing or sweeping. This would expose the top stones without disturbing the mass underneath.

The problem of dusting floors is also mentioned by Mr. Johnson. Here again thorough mixing is the remedy, coupled with a minimum of troweling. Troweling is the cause of much of the dusting of floors. This draws the laitance to the surface. This material has no strength or wearing quality in itself, and being on the surface has nothing to hold together—its sole function. Dusting is a natural consequence. The beautiful troweling of sidewalk pavements, to make them look good when the owner "comes across," is what makes them pit so badly a few weeks later. Sidewalks and floors should only be troweled enough to flatten the surface.

Mr. Johnson's paper would indicate that laitance on an ordinary job is several inches thick. Otherwise how could it flow off from a horizontal surface? Also what is the significance of his sentence, "How puerile appears the dainty surface picking of massive deposits of concrete usually required, when the usual depth of laitance is taken into consideration." It is true that the laitance may be several inches thick when a large quantity of concrete is deposited through water. Also it may be a good fraction of an inch thick on jobs where a large quantity of free water is slopped in with the concrete to obscure poor mixing and to make the stuff flow through an almost horizontal chute. The latter practice is reprehensible, but should not be confused with the employment of good, wet, freely flowing, properly mixed concrete.

It is a pity that the failure of the Austin dam should be blamed on bad concrete. This only obscures the fact that the design was bad. No stone concrete that was ever made would have been stable against the water pressure exerted on this dam. The pressures on the upstream face and the base of this dam, forces that could have been calculated and should have been anticipated before it was built, were enough to account fully for the failure. Why look farther?

Pittsburgh.

EDWARD GODFREY.

[The foregoing letter was submitted to Mr. Johnson, and his reply follows.]

SIR: Mr. Godfrey seems to labor under a misunderstanding as to the behavior and functioning of cement. If, as he says, "this material (laitance) is the real cement itself—the only part of Portland cement that has any real cementing value," and "this so-called slime or cream of cement, this laitance, is in reality the colloid, the active part of cement," and "the setting of Portland cement is merely the hardening of a colloid and what crystallization takes place is incidental and of no consequence," not only must all the rest of cement in concrete be what he terms "inert clinker of no value whatever as a cementing material" with any set of the mass inexplicable, let alone its well-known increase of strength with age in most instances, but also this quintessence of cement at the top should have most remarkable properties, all of which is exactly at variance with fact.

Mr. Godfrey's defense of porous concrete by drawing a parallel between it and sponges as offering, in each case, good value to the purchaser is neither fortunate nor true, because of their dissimilar uses. Nor can so ready a remedy as mixing $1\frac{1}{2}$ minutes, as recommended by the Joint Committee in its latest report, bring about entire relief from present suffering. It would be interesting as a sidelight on the efficacy of this suggested remedy to know what provisions the Joint Committee made for the enforcement of this recommendation and with what result, and also how many members of the Joint Committee itself are requiring in their specifications and in their superintendence that the quality of their own work shall be assured by a rigid adherence to this rule.

The problem of bonding new concrete to old and the complex problem of producing dustless concrete floors require more than a slight prolongation of splashing after the manner of purling waves upon a sparkling

shore. Nor is laitance merely a scum removable by brooms or by flushing, either of these exposing the top stones without disturbing the mass underneath. Surely there is some inconsistency, for if laitance is colloid and if this colloid contains the only valuable principles of Portland cement, there should be no necessity for removing it, or else, if through some unexpected circumstance this essence fails to retain the magic necessary for supreme usefulness, so that it is necessary to remove it, there must be some mistake either as to the method of removal proposed by Mr. Godfrey or else as to its thoroughness, inasmuch as it is difficult to determine (as anyone who has studied physical chemistry can appreciate) the depth to which solutions will merge one into the other.

Mr. Godfrey also wrongly assumes that which was specifically warned against in my article—namely, that an argument against excess water should be construed as an argument for dry concretes. Furthermore, resurrecting the Austin dam from its limbo is not necessarily to be called "a pity." Mr. Godfrey thinks much upon design and is unquestionably qualified to pass judgment upon this feature. But even granting the face value of what he says in regard to the Austin dam design, Mr. Godfrey should be the first to recognize that the best design can be negated by poor execution. Reason enough is provided in this fact alone for emphasizing the possible responsibility of execution for the Austin dam failure.

These comments on Mr. Godfrey's letter are almost unnecessary, as they are self-evident to those familiar with the true inwardness of concrete. Mr. Godfrey's letter, however, is potent for general misunderstanding. The making of concrete is essentially an exact science. Knowledge with regard to it is not general, but must become general if concrete is to prove worthy of its prestige. The haphazard method and the wrong practice so often openly sanctioned or permitted must give way to improved procedures, else there will be in the future less need for concrete design than is enjoyed at the present time. Progress and exact knowledge, rather than standpatism, are urgent and immediate necessities.

NATHAN C. JOHNSON,

New York.

Consulting Concrete Engineer.

Making a Success of Road Contracting

SIR: The article in your issue of Jan. 6, page 7, is exactly correct in that the execution of a road contract is more difficult than almost any other form of a contract. However, the exact reverse idea is prevalent with the general public. One of the most common causes of trouble on the job for both the contractor and the engineer is the inability of the general public to realize the difficult problems that arise in highway construction and maintenance. Nearly every man, whether he is a merchant, farmer, doctor or lawyer, feels that he is a natural-born road builder, and that he can solve any road problem, while in fact he has little realization of the true complexity of these problems. Such is the class of people that are most liberal with their adverse criticisms. I wish that every such person could read and realize the truth and force of the first paragraph of this article.

In the items set out under the heading of cost data,

I would make the change in numbers two and three as follows:

2. Be sure that the necessary quantity of the quality of materials specified is available. (a) Protect yourself against the prices of all such materials.

3. Figure everything accurately. Don't guess. Check your computations by different methods of calculation.

The change in item two seems to me to bring out a vital point omitted, while the change in number three simply adds more stress to a point brought out in the first three words under the heading of "Cost Data."

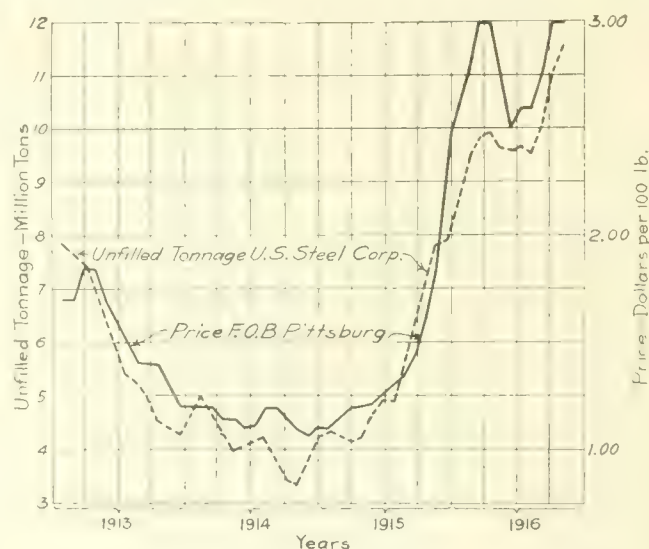
ARTHUR W. THOMSON,

County Surveyor, Marshall County, Indiana.

Plymouth.

Steel Prices Reflect Demand

SIR: The article on page 9 of the Engineering Record of Jan. 6 on the prices of construction materials is of interest to the writer, who has just completed an investigation of steel prices for the information of the buying staff of the company with which he is connected. Two curves plotted [reproduced herewith] indicate that steel prices show a suspicious tendency to follow closely the old law of supply and demand. The dashed line was



PRICE OF BARS FLUCTUATES WITH STEEL CORPORATION'S UNFILLED TONNAGE

made by plotting the monthly balance of unfilled orders published by the United States Steel Corporation, which is taken as a fair barometer of the demand for steel. The solid line is a curve showing the prices per 100 lb. quoted on corresponding dates for steel bars, f.o.b. Pittsburgh.

DAN PATCH,

Boston.

Aberthaw Construction Company.

Motor-Truck Legislation

SIR: The subject of regulation of motor trucks is not only interesting but is of vital importance to all the more thickly settled communities, and also to the "North Shore." We are all fast realizing that motor trucks must be carefully regulated in the very near future. Even now they are a problem with which engineers are at a loss to cope.

Personally I believe that not only the weights but

also the widths should be limited, and that they should be required to travel on the right side of the road owing to the noise some of them create, which makes it impossible to hear the horn of a vehicle attempting to pass. There should also be drastic regulations as to their use of roads, which at certain times of the year are incapable of supporting that kind of traffic without unreasonable damage.

Limitation of wheel widths should be written into our road laws, not only in regard to motor trucks but also in reference to narrow-wheeled horse vehicles. I do not think that the question need wait for five years to be of importance to us, and I am glad that you are bringing the subject to the attention of engineers and the public.

CHARLES E. RUSSELL,

County Superintendent of Highways.

Waukegan, Lake County, Illinois.

How Soon Should the Surface of Concrete Roads Be Finished?

SIR: In your issue of Jan. 13, page 75, is a letter from Edward N. Hines, the justly famous concrete road man of Detroit, seeking a discussion of the question as to the proper time for finishing the surface of concrete pavement. As Sioux City has achieved something of a reputation for its pavements, and as our method of finishing resembles his just as black resembles white, I am moved to write to you.

I would explain here, however, that my definition of "finishing" is not commensurate with the idea of simply putting the surface in shape to receive the traffic. It will be seen that the difference between our methods begins right in the beginning, with the definition of the term.

I do not agree with Mr. Hines that the proper proportioning of the mixture has been definitely settled, if he means by that that all are agreed on the proportions he uses, 1:1½:3. For one, I think that is too large a proportion of cement. It not only is not necessary, but may be positively harmful.

I think the value of an extremely rich mixture, in its relation to the wearing quality of a pavement, is greatly overestimated. Resistance to abrasion and to cracking is only another definition for "bond," and can be imparted more effectively in terms of labor than of cement. We use proportions of 1:2½:4, and our results compare favorably with those attained elsewhere, but we make up for leanness in cement by the addition of "elbow grease."

The proper quantity of water is another matter Mr. Hines assumes to be satisfactorily settled, but about which there still seems to be considerable misunderstanding. Water in concrete performs a dual service. One part is chemical and the other mechanical. The cement must be hydrated and the mass lubricated. A much larger proportion of water is required for the latter than for the former. It occurs to me that frequently when we think we are thinking of water for hydration we really have in mind water for lubrication, and the result is confusion as to just what is meant by the term "excess water." The proportion of water properly to lubricate the mass is very much in excess of the quantity required to hydrate the cement, so that from that point of view a concrete no wetter than Mr. Hines

recommends has an "excess of water." Note the fact that concrete used for all molded work—building blocks or drain tile, for instance—is dry and crumbly, and yet the cement is hydrated.

It is conservatively estimated that in an ordinarily wet concrete about 7 per cent of the mass is uncombined or "free" water. What eventually becomes of this water? Under ordinary methods of finishing concrete road surfaces, part is absorbed by the earth foundation and the remainder evaporates. The result is a slab with voids to the extent of the space occupied by this water; that is, about 7 per cent.

This water having been distributed evenly through the mass, the particles of fine aggregate are not evenly supported by the cementing agent, and are therefore easily abraded. Hence, a pavement that "dusts." Finishing a pavement where an excessively rich mixture is used soon after the concrete has been placed, and while it still retains this excess water, results in the formation of a thin scale, composed largely of laitance, or what concrete workmen call "cement cream," which peels under traffic. This accounts for the scaling and dusting noted by Mr. Hines.

Mr. Hines refers to the laying of concrete floors, and suggests the application of the method cited to the laying of pavement. In the laying of concrete floors, if the base is laid fairly dry, and tamped, and a comparatively thin wearing course applied immediately, the base will absorb the excess water in the top mortar, and finishing with the steel trowel can follow immediately. The water having been disposed of, and the mortar stiffened thereby (we accomplish this same result for our entire pavement slab by the application of a dry mixture of cement and sand), the troweling closes up the spaces it formerly occupied, resulting in a dense, close-grained wearing surface that does not "dust."

These methods, however, are not applicable to the laying of pavement. On the contrary, our method of laying concrete pavement is applicable to the laying of concrete floors, and I have in mind a certain garage floor, now about three years old, where the concrete laid in the forenoon was finished in the afternoon. Chains on the heaviest automobiles do no more to this floor than to leave a white mark. It is needless to say there is no sign of "dusting."

As to the length of time that should intervene between the placing of the concrete and the final finishing, there are a number of factors that enter into this determination. First, I would say that it is not the lapse of time but the condition of the concrete that should determine. It cannot be properly finished as long as there is water in or near the surface. The mass must receive treatment that will compact it, and this cannot be done while it contains water, because water is non-compressible. This water must be either absorbed by the earth foundation, driven out, or evaporated. After the water is disposed of, the pores must be closed, and the mass be made dense and impervious, if the desired resistance to abrasion or "bond" is to be secured. Mr. Hines lays his pavement under two very favorable conditions. One is his sandy soil, which, notwithstanding he wets it, absorbs his excess water and permits earlier finishing, and the other is the humidity of his atmosphere, due to the proximity of large bodies of water. This prevents a too rapid dryout. The first of these advantages he fails

to appreciate though, and takes no advantage of it. If he would use a roller, as is done in Macon, Ga., or some other method of compacting his concrete, he would get a denser pavement, and one less liable to crack or "dust." On the other hand, if he had our hot, dry winds to contend with, his surface would dry out before it had time to set, and would be filled with shrinkage cracks.

I hardly think the fact that in ordinary concrete construction mixed concrete is rejected after 30 minutes is sufficient ground for assuming that concrete pavement will necessarily be injured by continuous floating for a longer period. It is not so much that the floating disturbs the chemical process of setting as that it prevents the mechanical hardening due to loss of water.

About 1905 this office made a series of tests to determine the effect on concrete mortar of continuous mixing. The mortar was mixed continuously for nine hours, additional water being added from time to time. Every three minutes portions were removed and made into briquettes. The breaking of these test pieces showed an increase in strength up to about the third hour, and then a gradual decrease to a loss of about 10 per cent at the end of the ninth hour. The results of these tests were reported in the *Engineering News* at the time.

By continuous floating, the cement is kept moist and permitted to hydrate, the water is eliminated, and the concrete compacted and toughened. When setting is sufficiently advanced to render the mortar pasty and adhesive, we discontinue the floating.

Most of our pavement is finished about two hours after placing, much of it not till four hours after, and in the fall, some placed late in the afternoon does not receive the final floating until the following forenoon.

What are the results? We have a 16-ft. highway pavement in its second year that, on careful examination in driving over it, disclosed not more than one cracked section to the mile. We have streets a half mile long and 30 ft. wide and in their fourth year without a single cracked section. We have others of the same width and older with not 1 per cent of cracked sections.

T. H. JOHNSON,

Sioux City, Iowa.

City Engineer.

SIR: The question raised by E. N. Hines, chairman of the Wayne County (Mich.) Board of Road Commissioners, as to how soon concrete roads should be finished is a very important one and should receive more than a passing consideration.

The dusting of floors and the flaking of concrete road surfaces can in the main be attributed to the disturbance of the concrete at its most critical period of setting. Contractors perform work and engineers and architects draw specifications that are bound to cause dusting or flaking, as the case may be, if the specifications are followed to the letter. This is mainly due to the fact that the chemical actions of the setting and hardening of cement are not understood.

It is generally understood that the chemical action of the setting begins as soon as water is applied to the cement, and while this is true, until the process of crystallization is under way no harm will result from the disturbance of the mass. Le Chatelier definitely determined that the formation of crystals in setting cement follows certain laws, the first crystals formed being in the form of six-sided plates. From these plates crystal

points extend as the chemical action proceeds, these points attaching themselves to other points or plates or to any other body with which they come in contact. Once these crystal points begin to form, any disturbance of the mass fractures the points, and once fractured they do not unite again, either with themselves or with other bodies in the mass.

No hard and fast rule can be laid down for the finishing of cement surfaces, as three physical conditions tend to either prolong or accelerate the process of crystallization, these features being (1) chemical composition of the cement, (2) fluidity of the mass, and (3) heat. The writer has made hundreds of tests and observations of concrete work during the last sixteen years, and has found that under ordinary conditions not more than twenty or twenty-five minutes should elapse from the time the concrete is placed until all work on the mass should cease.

Owing to the shrinkage of the concrete mass, it will probably be impossible to secure an absolutely smooth surface free from depressions, but it is much better to have a slightly uneven surface than one in which the crystals have been more or less broken up. It is easy enough to produce floors that will not dust and roads that do not flake, and there is nothing mysterious about the process. In finishing surfaces within twenty to twenty-five minutes after the concrete has been placed, it is often necessary in places to remove an excess of water by means of burlap or other absorbent material.

Mr. Hines, in the third paragraph from the last in his letter, says: "Mix your concrete dry by using the correct percentage of water." It has been thoroughly demonstrated that a "dry" mixture must of necessity be very much more porous than a wet mixture, inasmuch as the dry mixture when placed has an excess of voids which are filled with air, and which all the tamping and puddling that may be done will not eliminate, owing to the extreme elasticity of air. It might be possible in this way to get a surface that would not flake, but the quality and durability of the concrete would be seriously affected, especially in a latitude where there is a great deal of freezing and thawing. The disrupting power of frost is too well known to need comment.

There are a number of things that go to make up an ideal concrete road, and two of the most important features outside of the proper proportions of the mixture are: (1) that the concrete shall be mixed wet enough and to such a degree of plasticity as to make the mass as dense and as nearly impervious as possible and (2) that the mass shall not be disturbed under any circumstances after the formation of crystals has begun, even if the surface does not present an absolutely perfect contour.

J. EDWARD CASSIDY,

Chief Engineer, Foster Construction Company.
Newark, N. J.

Wants Timber Branded with Grades

SIR: Permit me to compliment you on the editorial in your issue of Dec. 30, 1916, page 787, on the revision of the grading rules of the Southern Pine Association for "select structural" grade.

I firmly believe that this change in the grading rules is a step in the right direction, and I am also convinced that the Southern Pine Association should go further

and revise its rules by providing for the branding of timber, not only with the name of the manufacturer but also with the grade, in order to simplify inspection of timber by those not especially skilled in the determination of timber grades.

At present it is possible to secure Southern pine timber branded with the name of the manufacturer only, but such branding does not mean anything. It is somewhat surprising that the Southern Pine Association has not as yet officially adopted a rule for the branding of timber with the grade, in view of the numerous demands which have been made by the users of timber, including the National Retail Lumber Dealers' Association.

F. E. DAVIDSON,
Consulting Engineer and Architect.

Chicago.

Form for Filing Records of Construction Conditions

SIR: Many valuable lessons are lost to the engineering profession by reason of the failure of the engineer to keep and preserve records of his experience. When no records are made, even the engineer in constant charge of the work sometimes finds his memory a very poor reference when he wants to study the methods and conditions that may have contributed to the success or failure of a certain piece of work. Sometimes valuable data are collected in the form of daily reports, memoranda or diaries, but usually these are pigeonholed after the work is completed, or filed away in unused files and lost in the mass of data seldom if ever referred to.

In the case of road building, how valuable it would be to the profession to-day, in studying some of our old and successful types of roads, if we knew in detail all the conditions under which the work was done—the

materials used and their condition, the methods of construction, weather conditions, care used in protecting the work, and the many other little details that may have contributed to the success of the work.

Likewise, in the case of roads that have failed, these data are of no less value to the engineer interested in road problems. And inasmuch as the success or failure of a road may only be determined after many years of service, the construction records are of greater value as the years increase.

With a view to preserving the engineering data collected during the construction of the roads, and compiling them in a form that may be of service later to other engineers, as well as to the state and the county, the writer has adopted a graphic form as shown in the illustration. It may be prepared on profile or cross-section cloth or on plain tracing cloth. The form is self-explanatory.

The data shown have been collected from the inspector's daily reports, diaries, personal observations, and other notes and memoranda made by the engineer. The graphic form is made up during rainy days, or in the winter season, when construction work is at a standstill. Copies are filed in the office of the county engineer, the clerk of the county court, and with the state road bureau.

W. S. DOWNS,
Road Engineer, Monongalia County, West Virginia.
Morgantown.

Growth in Public-Road Revenues

Bulletin 390 of the U. S. Department of Agriculture reports that the total revenue applied to roads and bridges, and derived from appropriations, motor-vehicle registration and license fees has grown from \$79,623,616 in 1904 to \$240,263,784 in 1914, an increase of 201.75 per cent.

ENGINEER'S RECORD OF CONSTRUCTION CHEAT RIVER ROAD NO. 1, MONONGALIA CO., W. VA. CONCRETE BASE, CEMENT-SAND CUSHION, BRICK SURFACE, CEMENT GROUT FILLER HOTTELL CON. CO. CONTR.			
CEMENT GROUT FILLER	Oct. 8, 1916 580' Weather - Clear - Max. 75° Min. 59° Materials - Atlas Cement, Monongalia River Sand Mixture - 1 1/2 - Machine Mixed Cement Used 114 Sacks - Covered with Sand Oct. 9 Note - Heavy team, drove over pavement night of Oct. 9		
BRICK PAVING	Oct. 7, 1916 290' Weather - Clear - Max. 72° Min. 50°	Oct. 6, 1916 281' Weather - Clear - Max. 70° Min. 45° "Grafton" Wire-Cut Log Block	* "Grafton" Re
CEMENT-SAND CUSHION	Materials - Atlas Cement Sand - Crushed Pgh. Sandstone (25% voids) Mixture - 1:4 - Machine Mixed Cement Used - 78 Bags Note - Cushion about 1 1/2" thick. Flooded and set up Oct. 7 -		
CONCRETE FOUNDATION	July 18, 1916 397' Weather - Clear - Max. 95° Min. 60° Materials - Atlas Cement Fine Ag. Crushed Pottsville Sandstone (40% voids) Coarse " " Connellsville (45% ") Mixture - Base - 1:2 1/2 : 5 Curb - 1:2 : 4 Cement Used - 630 Bags Covered with Earth July 19	Mixer Worked 9 1/2 Hours Cement Required - 579 Bags	July 9, 1916 346' Weather - Clear in Morning Rain in Afternoon Max. 78° Min. 66° Materials - Same Mixture - Same Cement Used - 164 Bags Cement Required - 334 Bags Covered with Earth July 20
SUB-BASE	Sub-Base Low Clay and Loam Sub-Soil well Rolled with 10 Ton Roller Left Material Excavated and Refilled with Dry Shale Wet Spot		
STATION 0	1	2	3 4 5

THIS FORM IF CAREFULLY KEPT CAN BE MADE TO SUPPLY MUCH VALUABLE INFORMATION

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Pile Driver Working Near Siding Unloads Tanks and Saves Demurrage

By GEORGE A. GIORLOFF
New York City

TWO SHIPMENTS of cylindrical steel tanks for use in constructing the plant of the White Tar Company near Kearny, N. J., came through with unexpected promptness and reached the job before arrangements had been made to unload them at the proper point for storage. In these days of high demurrage rates, it would have been expensive to hold the cars, and as several of the tanks weighed a ton or more, and all were loaded in gondola cars, it would have been slow and expensive to take them off by hand. An ordinary land pile driver, working within 200 ft. of the spot where it was desired to store the tanks, was moved over facing the side of the car and used to lift out the tanks and land them. It was necessary to build a short runway and turn the driver around to reach the side of the car. In unloading, the driver was run up to the car to raise each tank, and backed up about 20 ft. each time to land the tanks. The moving was done with the pile line, which was a wire rope, and the tanks were raised at the hammer line, which was of manila rope. The drop hammer was toggled at the bottom of the leads. The larger shipment, containing seven tanks, was unloaded with a total delay to the pile driving of 6 hours.

The plant mentioned is being constructed by T. L. MacBean.

Ever Run a Hoist? Own One? Does This Sound Familiar?

WHILE the master mechanic from Omaha or New Orleans may not be in need of advice from Brooklyn, everyone who has had to do with hoisting equipment will appreciate the following "hoist runneries" contributed by a reader who resides in the last-mentioned city, and who has evidently met with troubles of his own:

If the monkey wrench wasn't handy and you tightened the nut with a hammer and chisel, forgetfully leaving the chisel on top of the gear, what could you say when asked, "What broke that tooth?"

"Oh, it just fell out. Wasn't even hoisting a load; just turned the engine over and it dropped right out. They've got putty instead of iron in that gear."

If the brake was greasy or needed adjustment, and your load got away, and you threw in the dog to stop

the drum, how could you answer the question, "What bent that shaft?"

"Oh, anybody can see that the shaft is too small, and look at the soft steel in it. It's awful. Why don't they just stick a match through the drum and be done with it?"

If your rope lead was too short or onesided and the line kept crossing and sawed the strands through; if you forgot to break her in time and the slack rope got all tangled and kinked; if your lead sheaves were stationary from want of oil, what should you say when asked, "Why are you putting on a new rope again?"

"I never saw such a rotten line in my life! Don't believe they can make the steel nowadays that they used to. There is no strength to it at all. She strands when running the bare hook. Anyway, the barrel is too small for that sized line, and it's all a man can do to bend it around the drum."

If you left the oil and grease uncovered, and it got full of grit, and your bearings started to cut and heat, the brass bushings and washers sifting yellow spots in the muck on the floor, how could you reply to the question, "What! relining her again?"

"Sure. This is my steady job every Sunday. The chief buys the cheapest grade he can find. Nothing but acid. Probably gets a rakeoff. You might as well use water, for all the good it does. This hoister never knew it had any oil. Anyway, the bearings are too short; should be twice as long."

If you absentmindedly left your wrench on top of the guide, and busted the crosshead, twisted the connecting rod, bent the piston rod and broke the guide bar, smashing up one side of the engine generally, what should you say to the polite inquiry, "What caused the smash-up?"

"Smash-up nothing! She just laid down, that's all. Too small for the job. She just kept going until she died. If they only had made both sides alike, she'd probably have held together for a while yet, but she's through now."

If the boiler was too full, and foaming for want of cleaning, or if the feet and braces were so loose that she was shaking water into the steam pipes and you were running "hydraulic"; and if the drips were plugged or busted, and your cylinder or backhead cracked, how could you pass off the remark, "What's the trouble now?"

"This is no trouble—just everyday performance. One thing breaks, then another. It keeps me going fixing the blamed thing all the time. That cylinder is

SAM MARTIN was a mighty slick contractor—he kept everything under his hat;

AND BILL BIRD, his rival in the same town, couldn't keep a secret; everybody knew all about the nifty tricks Bill used to turn;

AND A BIG PRIVATE JOB came up.
AND SAM WAS LOW, but Bill got it,
AND SAM KICKED to the engineer,

AND THE ENGINEER TOLD HIM: "We don't know anything about your methods, but we know that Bill has *brains*. Look at all the short-cuts he gets up. Why, they tell about his stunts in
HINTS FOR THE CONTRACTOR."

so full of blowholes, it's a wonder she didn't let go long ago."

If you didn't think the night would be so frosty, and neglected to drain her, you might reply to "What bent that valve rod, and how did that pipe burst?" with: "Oh, I've been expecting that for a long time. That rod was bent before I came on the job, anyway. It's too small, almost breaks her off screwing up the stuffing box. And that pipe—why, she just opened up in the seam, that's all. Bum weld, I guess. She's been leaky for some time."

Large Pipe Line Supported at Grade Over Coffin in Soft Soil

By H. W. STREULI
Schenectady, N. Y.

A FORTY-EIGHT-INCH cast-iron pipe with lead joints, which at times ran full of storm water, had to be supported rigidly on soft soil across a 42-ft. wide cofferdam during the construction of a Venturi meter chamber on the Passaic Valley sewer in New Jersey.



LOAD WAS TRANSFERRED TO BRIDGE BEFORE SOIL UNDER PIPE WAS DISTURBED

Any deflection or settlement might have caused a rupture of the joints, with serious consequences.

The excavation at this point was 40 ft. deep and was made inside steel sheeting. The soil was running sand throughout, with the ground water level only a few feet beneath the natural surface. Support from the trench bracing being out of the question, a trussed support spanning the cofferdam was built as shown in the photograph.

As settlement outside the steel piling was anticipated as a result of bleeding the surrounding territory in pumping out the dam, the bridge was designed to support 60 ft., or six full lengths, of pipe. It consisted of two 60-ft. 12x12-in. longleaf yellow-pine timbers, spaced parallel 3 ft. center to center directly over the pipe line. These timbers rested on cribbing at each

end, placed so that no direct pressure was transmitted to the section of the pipe line beneath. This cribbing was built up with a view to inserting jacks and wedges to take care of any future settlement. On top of each long timber another 40-ft. stick of the same size was scabbed symmetrically. An 8x8-in. timber 6 ft. long was then spiked horizontally across each end of the long timbers and holes bored in them on each side for 1½-in. truss rods. Four truss rods, one on each side of each timber, were tightened under two wooden bolsters placed at the third points, as shown in the illustration. The bolsters and threaded ends of these rods were fitted with plate washers.

After this structure was assembled, the excavation was carried down to the bottom of the pipe, permitting slings of 5/8-in. wire rope to be passed under the pipe at each point. These ropes, doubled and fitted with turnbuckles, were fastened to the ends of 8-in. round timbers placed on top of the supporting timbers over each joint.

Level readings were then taken on each length of pipe and on the cribbing. The turnbuckles were then tightened until the pipe line barely started to rise, any settlement of the cribbing as the load was taken being overcome with wedges and jacks. In this way the temporary bridge was fully loaded and all deflection taken up before the soil under the pipe line was excavated, and without disturbing the grade of the line itself. Level readings were taken each day on both pipe line and supports, and settlement immediately corrected. Although the pipe line was supported for many months, no trouble was experienced, the load having since been transferred to the permanent structure. The writer was in charge of the work as superintendent for the contractor.

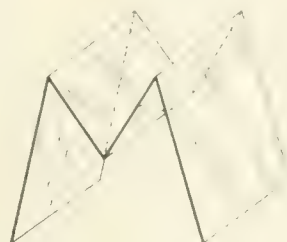
Bent Sheet-Metal Reinforcing Chairs Obtained Cheaply at Local Shop

By JOHN E. LANGLEY
Huntington, W. Va.

CHAIRS for supporting reinforcing steel were made by bending strips cut from old metal at a local shop and delivered to the job at a cost of \$1.50 per 100 during the construction of the United States custom house and post office at Shreveport, La. The chairs were used later in constructing another building in the same city, and gave perfect satisfaction on both contracts.

These chairs proved strong and withstood rough handling. Forms and chutes were dropped on rods thus supported, and loaded barrows were wheeled over them without displacing or injuring any of them. Concrete flows readily around and between the legs of the chairs, and after the removal of the forms the thin metal strips of the legs did not show at all on the ceiling.

The chair also possesses an advantage in holding reinforcing firmly against lateral movement. It is neither patented nor patentable.



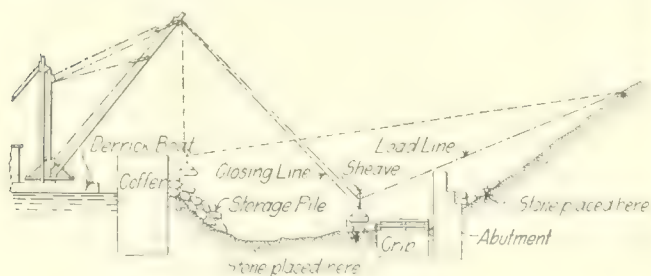
Trolley Principle Applied to Handle Three-Ton Stones with Derrick Boat

By G. W. McALPIN
New Richmond, Ohio

A DERRICK boat equipped with two lines for handling a grab bucket was recently converted into a cableway for handling heavy riprap stone to a considerable distance beyond the reach of the boom by using one of the lines for a track cable and the other to manipulate a single-block trolley. The same principle has been employed in other places, an instance of its use on the Sabine-Nachez Guard Lock having been cited in the Engineering Record of Nov. 27, 1915, page 674. The present case, however, differs from that mentioned in the direct use of the track cable for doing the hoisting and the attachment of the second cable to the block below the track cable. Also, as the derrick could readily be moved without unrigging the trolley, it was easy to cover a larger area from one anchorage.

The rig was used at Dam 35 to place a quantity of stone, which was not sufficient to justify setting up a derrick, in locations out of reach of derrick boats outside the cofferdam. The end of the load line from the three-drum hoist on the derrick was anchored to a deadman in the hill back of the abutment wall.

The trolley was made of a large sheave running this line with an iron strap on either side carrying chains and stone hooks. The closing line from the hoist on the



DERRICK BOAT QUICKLY RIGGED TO "TELEGRAPH" 3-TON STONES

boat was made fast to these straps and was used to check the load when it reached the required position. By carefully slackening both lines, the load line slightly more than the closing line, the load could be lowered accurately into place.

In operation, the boom on the derrick boat was raised to nearly vertical position. Many of the stones placed in this manner weighed as much as 3 tons apiece, but were easily handled.

Coils Fitted in Old Salamanders Make Water Heaters for Subway Concrete

PORTABLE water heaters made by fitting coils of 1-in. pipe inside old salamanders are being employed by the Holbrook, Cabot & Rollins Corporation to heat the water used in remixing concrete for the subway structure on this company's section of the new Broadway line in New York City. As described in the Engineering Record of Dec. 23, 1916, page 760, the concrete for this section is mixed rather dry at a central plant located on the contractor's North River dock and hauled

to the job in motor trucks. After being dumped on the street decking, more water is added, the concrete being remixed with hoes before being spouted to the forms below. During the cold weather it has been necessary to heat the water used in this remixing.

It is economical, of course, to deliver the concrete directly above where it is wanted, the hopper through which it is sent to the form being moved frequently as the work progressed. Therefore some form of water



WATER RUN THROUGH HEATING COIL IN OLD SALAMANDER

heater was required which would be more portable than the usual makeshifts resorted to, and which would be less of an obstruction to traffic. Several old salamanders, fitted with coils of pipe in the contractor's shop on the job, solved the problem. In use, the heater is connected to the nearest water line by a hose, coupled to the lower end of the coil inside the salamander. From the upper end of this coil at the top of the salamander a second hose 10 or 12 ft. long runs to the hopper. This hose is fitted with a plug cock next the salamander, so that when the line is not in use the water is shut off beyond the point where it is being heated.

To avoid playing a heavy stream on the concrete and washing out part of the cement, a sprinkler nozzle is attached to the end of the short hose, being bushed to a short length of pipe. To this pipe is secured a 1/2-in. steel rod about 4 ft. long, which is stuck into the pile of concrete and supports the sprinkler at the desired point. With this arrangement the water "rains" down on the point where the concrete is being remixed with a hoe, and all washing is avoided.

The heaters have to be drained during very cold weather when not in use, as the wood fires in one or two of them went out recently on a cold night and the coils froze and burst.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Minnesota Proposes City-Manager Plan

Measure Before Senate Would Apply to All Towns of Less Than 10,000 Population

Adoption of the city-manager plan for the smaller cities of Minnesota is proposed in a bill before the Senate. The act applies to fourth-class cities, including all having less than 10,000 population, but is not to be put into effect until submitted to the people on petition of 20 per cent of the voters and adopted by a majority vote.

The bill provides that the town council would be left merely a legislative body, and provides for an elective civil-service commission, with general authority to employ help in the city departments, and for the naming of three members of a public utilities board, one of whom is to be chairman, one vice-chairman, and the third, to be chosen without regard to residence, to be city manager.

The city manager is to take the place of the city engineer, surveyor and street commissioner, and may act also as city recorder or clerk. He is to be responsible only to the other two members of the board, who may remove him at any time on written notice. His salary is to be fixed by the civil service commission.

Department of Agriculture Refutes Roads Reports

The Secretary of Agriculture gave out a statement Feb. 17 to refute the report that states desiring to obtain money for roads under the Federal Aid Road Act, which appropriates \$85,000,000, must build only expensive roads, and to make it clear that no particular kind of material will be required or favored by the Department of Agriculture to the detriment of other materials.

"There is not the slightest truth in such a report," said Secretary Houston. "This department, which is charged with the administration of the Federal Aid Road Act, has placed absolutely no restrictions, either direct or implied, upon the kinds of highways to be constructed. States may submit for approval any kind of road, even an earth road, and approval will be given if the construction be substantial in character, suitable for traffic needs, and meets the terms of the federal act. To give state legislators and highway officials the impression that this department favors only costly types of road, or discriminates in favor of any particular material, results not only in spreading misinformation, but in placing barriers in the way of states which wish to avail themselves of federal aid in road construction."

Indiana State Highway Commission Shorn

The effectiveness of the proposed Indiana State Highway Commission was destroyed when the power of letting contracts for main market roads was taken from it and placed in the hands of the county commissioners in an amendment passing the Senate Feb. 12. The amendment also provides that the State highway engineer must submit specifications for two or more kinds of material for any proposed roads.

Back of the bill in its original form were the farmers' organizations, the livestock associations, the Indiana State grange, the traveling men's organizations, the Indiana Bankers' Association, the chambers of commerce throughout the State and many other civic and business organizations.

Metric System Adoption Gaining Headway

The Pan-American use of the metric system was agitated at the "metric conference" during the sixty-ninth meeting of the American Association for the Advancement of Science, held in New York during Christmas week, 1916. The outcome of the conference, which was attended by representatives of national business organizations, the U. S. Department of Commerce and men prominent in engineering and educational work, was the formation of a permanent organization to be known as the American Metric Association, the object of which was to further the adoption of the international meter, gram and liter, which have been legalized in the United States since 1886.

Officers of the Association

The officers of the association are as follows: President, George F. Kunz; vice-presidents, William Jay Schieffelin, E. R. Albrecht, and O. E. Stanley; treasurer, Arthur P. Williams; and secretary, Howard Richards, Jr., 156 Fifth Avenue, New York City, the address of the association. The executive committee consists of H. V. Army, Fred R. Drake, A. E. Kennelly, S. W. Stratton, and W. P. Wilson.

The association is especially desirous of receiving catalogs of manufacturers who use the metric system for domestic or export purposes.

Government Active in Industrial Preparedness

Signs at Washington Point to Preparations on a Scale of Unprecedented Magnitude

By the Engineering Record's Washington Representative

The United States of America, so far as industry is concerned, is rapidly being placed upon a war basis, reports from Washington show, as the result of the notification, Jan. 31, of the German government that unrestricted submarine warfare will be resumed notwithstanding the protests of the United States. A military war basis is also being brought about, to a certain extent.

Mobilization of Industrial Resources

The "mobilization of industrial resources," which has been so much talked of recently, is in fact now being given a practical test. Secretary Daniels of the Navy Department and Secretary Baker of the War Department have been in daily conference with members of the Naval Consulting Board and the National Defense Council. There have been filed with the Navy Department inventories of 1200 manufacturing plants which could produce war material, and a great many manufacturers of all classes of machinery, chemicals, etc., have placed their plants and their personnel at the disposal of the government for use if needed.

The outward signs of these activities in Washington are in great increases to the army and navy appropriation bills now in Congress, and another bill to place \$150,000,000, by means of a bond issue, at the disposal of the President, available immediately. This sum is likely to be greatly increased, as official Washington recalls that at the outbreak of the Spanish-American War \$50,000,000 was appropriated within 15 minutes, but it is realized that that sum, or triple that sum, would be but "a drop in the bucket" to-day, in view of the fact that \$50,000,000 would not any more than buy two modern battle-ships, with arms and armament.

Outward Signs of Activity

Another outward sign of the mobilization to be seen in Washington is the fact that the State, War and Navy building has been closed to visitors. The government departments at Washington do not desire calls from contractors, builders, engineers, salesmen, etc. They cannot even obtain access to the departments except upon written passes issued before Saturday, Feb. 3, and every employee, from cabinet offi-

NEXT WEEK

Prices of Construction Materials

cers and the chief of staff of the army and the chief of staff of the navy down, is obliged to present such passes to the sentries on duty. Representatives of the industrial resources of the country who have material to offer the government must make their offers in writing and send them by mail.

The government is placing contracts in some cases without bids and in other cases is about to ask for bids for millions and millions of dollars' worth of equipment—all sorts of machinery and supplies which would place the country upon a war footing. Immediate purchase of reserve supplies, depleted because of the last Mexican crisis, has been ordered, and War Department purchasing agents were last week sent out into the open markets to obtain these supplies.

Appropriation Bills Before Congress

The army appropriation bill, the fortification bill (a separate measure), and the naval appropriation bill are well on their way through Congress. There have been added to the regular naval appropriation bill the sum of \$15,000,000, one-third of which is for ammunition for merchant auxiliaries. There has been added to the regular army appropriation bill the sum of \$8,000,000 for aviation, \$11,000,000 for equipment and stores for the officers' reserve corps, and \$5,500,000 for automatic machine guns for the army and national guard. A separate bill carrying \$1,000,000 for the purchase of basic aeroplane and seaplane patents has been presented.

There is no question of the passage of these measures, nor is there any question that there will be written into the navy bill authorization for the Secretary of the Navy to take over for the government any private plant the government may need in a war emergency. The government has already practically taken over the private radio plant at Tuckerton, N. J., and within the past few days has replaced the civilian operators with United States Navy operators. Telephone, telegraph and wireless companies all over the country have offered their services and their plants to the government, and upon one occasion immediately following Germany's announcement, the afternoon of Feb. 1, a practical test of governmental use was put into effect on long-distance telephone wires out of Washington.

Navy Department Active

Orders have gone from Washington closing the navy yards of the country, and army and navy officers in Washington are acting as censors of news in the War and Navy Departments. The naval station at Newport has been instructed to enter upon the manufacture of torpedoes upon an extensive scale, and a board of officers has left Washington to examine proposed sites at Charleston, W. Va.; Cumberland, Md., and other points to determine their fitness for the government armor-plate plant previously authorized. It is expected that there will be early action

upon the government nitrate plant also previously authorized; and there is a harmony of feeling between Democrats and Republicans alike in Congress as to national defense measures, instanced in the fact that the Republicans have caucussed and have agreed to vote for an appropriation to build immediately 100 more submarines than are authorized in the pending naval bill if the Democrats should bring in such a measure.

Salt River Irrigation Work Is Declared Completed

After several years of delay and much dispute over a proper assessment of costs, the Salt River irrigation project in Arizona has been declared completed. The office of the Salt River Valley Water Users' Association received formal notice to this effect Jan. 23, together with particulars of the method to be adopted for repayment of the moneys expended by the government in the building of the Roosevelt and Granite Reef dams, purchase and completion of the distribution system and installation of hydroelectric power plants.

The local association claimed that several millions have been wasted in useless and unutilized work, and has demanded subtraction of such sums. Only a relatively small subtraction has been made, however, and the project is assessed for the repayment at \$60 an acre, or about \$11,000,000 for the 183,000 acres that now have advantage of the water storage and distribution system. It is reported that this assessment rate will be contended by the users' association.

Repayment

Repayment of the assessed amount, under the amended terms of the Reclamation Act, will be spread over a twenty-year term, without interest. On Dec. 1 next the first installment will be due. It will be of 2 per cent, as will be the next three yearly payments. All following installments will be of 6 per cent. Within six months from date all land owners must signify their acceptance of the terms, the payments to constitute a first lien upon the lands. No one may be included for more than 160 acres, and the owners must live on or near the land. The first year's charge for maintenance and operation expense will be 75 cents an acre. The large sums received for electric power will be credited upon the principal amount.

Atlanta to Proceed with Terminal Improvements

A plaza terminal commission for the city of Atlanta, Ga., was created by ordinance Jan. 13 to carry into effect the proposed plaza scheme to improve terminal facilities for the city as proposed by Barclay Parsons & Klapp, consulting engineers, of New York City. V. H. Kreigshaber and P. H. Norcross, consulting engineers, of Atlanta, were appointed members of the commission.

St. Louis to Convert River Into Big Sewer

A plan to convert the River Des Peres into a big sewer at a cost of approximately \$6,500,000 has been approved by the St. Louis Board of Public Service. The sewer, if built according to plans, will be 13 miles long and will cut more than 3 miles from the stream's length by straightening it out and "harnessing" it. The plan adopted will not be put into effect until the necessary funds are available, but formal approval by the board means that when the work is undertaken it must follow the plan placed in the board's record.

The plan calls for a single-barrel tube 32 ft. wide and 25 ft. high extending from the western city limits to the Union Avenue entrance to Forest Park. The section through Forest Park to Macklind Avenue would contain two tubes, each 29 ft. wide and 24 ft. high. The section from Macklind Avenue to the Mississippi would be an open concrete channel ranging from 90 ft. in width at the top to 200 ft. as it nears the river.

The River Des Peres, ordinarily a shallow stream, drains the hill country southwest and west of St. Louis, and in time of heavy rains becomes a torrent that floods streets and homes. If the sewer is built it is hoped the flood menace will be removed.

California Proposes County Highway Engineer

A bill now before the state legislature of California (Ream Assembly Bill No. 209) proposes to create the office of county highway engineer for each county in the state. This engineer would have all the authority for road work which is now vested jointly in the Board of Supervisors and the county surveyor. The engineer would buy or otherwise arrange for all necessary equipment for road building and would bear much the same relation to county-road work as does the state highway engineer to the road work of the state.

Employees' Welfare Cared For in Electric Company

To supervise education, employment and provision of opportunities for advancement of employees is the purpose of an industrial service department established by the General Electric Company at its Schenectady plant. The new welfare work will be under the management of E. B. Merriam, who has been connected with the company for 16 years, starting as a student in the testing department, and who now resigns from assistant engineer in the switchboard department to take up his new duties.

Engineer Office Abolished

The borough council of Carlisle, Pa., has abolished the office of borough engineer and will employ a consulting engineer when work is to be undertaken which would require such services.

Commission Engineers as Reserve Officers

As a result of legislation in the Army Reorganization Act passed last summer the War Department has examined and the chief of engineers of the Army has recommended for commissions about 340 officers in the Engineer Officers' Reserve Corps out of a total number of applications for examination amounting to about 1100. The prospect is that the United States will have in the near future many more officers, if needed, than are available from the supply of West Point graduates to serve in case of actual war with Germany. Examinations are taking place all the time, and the 340 engineer officers mentioned, as well as others to be passed upon, will be commissioned as majors, captains and first and second lieutenants.

One section of the corps for each branch and the staff of the Army is being formed, these including the arms of infantry, cavalry, field artillery, coast artillery, medical, adjutant general's, judge advocate general's, inspector general's, quartermaster's, ordnance, signal and engineer corps. Progress in the formation of the different corps similar to that among the engineers is being made in all these branches of the Army and the staff.

Idaho Engineers Are Opposed to Monopoly of Resources

Resolutions opposing legislation that would make water rights distinct property, independent of the land, were passed by the Idaho Society of Engineers at its closing session of the recent convention in Boise. The resolutions adopted stated that "soil and water are joint agents of production wherever irrigation is necessary, and the divided control of these agencies encourages speculation, tends toward monopoly of our natural resources, and stands in the way of obtaining the highest duty of water in irrigation."

Propose Water-Power Commission for New York

The establishment of the Water Power Development Commission of New York State to consist of the state engineer and surveyor, conservation commissioner, attorney-general and superintendent of public works, to investigate the character, value and extent of location of surplus waters of the state available for power or other electrical development and report to the Legislature Feb. 1, 1918, is provided for in a bill introduced at Albany Feb. 9. The members of the commission are to serve without additional compensation. The sum of \$40,000 is appropriated for expenses.

The introduction of this measure is thought to mark the revival of the hydroelectric activity which was actively supported by Governor Glynn in 1913.

Spring Flood Feared on Rivers in Pennsylvania

Fearing that floods may occur this spring from ice gorges in the two streams, Pennsylvania's Water Supply Commission, with main offices in Harrisburg, is keeping a watchful eye on the Susquehanna River and Alleghany River watersheds. Oil City reports an ice jam 60 miles long in the Alleghany River and the ice is gorged for more than 75 miles in the Susquehanna, beginning 15 miles north of Harrisburg and continuing toward the bay.

Ten years ago several hundred thousand dollars damage was done at Middletown, Pa., when the ice gorged and backed up the flood waters. It is said that the ice is 2 ft. thick in places, and cakes are jammed one upon another to a height of 15 to 20 ft. February and March are the months of heavy snows in the Susquehanna watershed, and when the spring thaws come, trouble is more than likely, says the commission.

Begin Work on Irrigation Canal in Washington

A corps of engineers will be put in the field at once on the proposed irrigation canal to water 120,000 acres in the Wenas, Selah and Moxee valleys and a considerable amount of land above the present Lewinpipe Canal below Union gap, according to R. K. Tiffany, manager U. S. Reclamation Service at North Yakima, Wash. Estimates for the work will be submitted to the Secretary of the Interior at Washington, D. C. Water will be taken from Naches River, also storage water from the present work, as more water is now stored than is needed at the McAllister Meadows reservoir.

Decision Affects Repaving of Pennsylvania Streets

The State Supreme Court of Pennsylvania, in refusing on Jan. 31 to hear the appeal of the city of Pottsville from the adverse decisions of the Schuylkill County and superior courts in its action to compel abutting property owners on Market Street to defray assessments covering the cost of installation of wood block pavement on the thoroughfare, has made binding the law, applying to all third-class cities in the state, that streets which are macadamized cannot be paved at the expense of abutting property owners. This decision also practically annuls that provision of the Clark act operative in the state creating a commission form of government and giving city councils the express authority to improve macadam streets and assess property owners for the cost of the new paving.

Prior to the rendering of this decision, forty-five property owners defrayed their share of the expense, and it is said that the legislature will be asked to refund this money.

Water-Power Bill in Congress Receives Little Consideration

As the result of opposition in the Senate, principally on the part of Senator Fall of New Mexico, there has been but little consideration in that body of the bill to provide for the development of water power and the use of public lands in relation thereto. One of the most serious stumbling blocks in the way of the bill has been presented by Senator Fall, who has announced that he will vote against the measure, "with or without discussion," an attitude that will have its effect on other senators because of the state Senator Fall comes from and the presumable interest of that state in the measure. Senator Townsend of Michigan has also objected to the consideration of the bill.

North Dakota Engineers Propose Licensing Law

A licensing law for land surveyors was again submitted to the legislature by the North Dakota Society of Engineers at its annual meeting Jan. 30 and 31 in Bismarck. The law provides for the examination (and licensing upon due proof of qualifications) of land surveyors in the state, and requires that none except licensed surveyors shall be allowed to hold the office of county surveyor, or issue surveyors' certificates or certify plans or plats for filing in any case where the location of property lines is thereby involved.

Officers elected for the coming year are: President, J. A. Ingram; vice-presidents, R. H. Slocum and J. H. Clark; secretary-treasurer, E. F. Chandler, University, N. D.

The next annual meeting will be held at Fargo.

Swiss Asks American Engineer's Advice on Bog Drainage

A much-censored letter was recently received by H. B. Walker, associate professor of irrigation and drainage engineering, Kansas State Agricultural College, from L. C. Bryan of Villa Miguel, Switzerland, relative to the possibilities of draining a large Swiss swamp. The letter in part follows:

"I am interested in reclaiming a tract of bog land that is covered with water three months of the year in ordinary times. It has been raining almost incessantly since the war began three years ago. In ordinary times there is little or no water here, however, for nine months in the year.

"Will you advise me as to the best methods to follow? We could erect windmills to do the pumping or we could use electricity, for it is very cheap here. The land is entirely surrounded by the embankments of the country highways. All of the Rhone Valley is to be drained under the supervision of the State engineers within the next two or three years, but this bit is a corker to them."

Engineering Society Activities

Engineers' Society of Northeastern Pennsylvania has elected the following officers for the ensuing year: President, Frank J. Duffy; vice-presidents, J. M. Humphrey and J. M. Gaynor.

Indiana Engineering Society has elected the following officers: President, C. F. Harding; vice-president, W. H. Insley; secretary, Chas. Brossmann, Indianapolis, Ind.

Binghamton Engineering Society has elected officers as follows: President, Robert B. Hoadley, Jr.; vice-presidents, Frederick E. Beck, Clarence A. Dayton and Carl E. Anderson; treasurer, D. M. Edgerton; secretary, W. Earl Weller.

Kansas Engineering Society has elected the following officers to serve for the present year: President, H. B. Walker; vice-president, Con. M. Buck; secretary-treasurer, C. A. Haskins, Lawrence, Kan.

Engineers' Club of Seattle announces the following officers: President, E. B. Hussey; vice-president, R. H. Ober; secretary, J. Thomas Dovey.

What Engineers and Contractors Are Doing

E. K. SHEBLE, contractor and engineer, until recently with the Washington Construction Company, Seattle, has become associated with the Stone & Webster Engineering Corporation, with headquarters at Boston. Mr. Sheble was for three years connected with the engineering department of the city of Seattle, after which he joined the Washington Construction Company.

FRED BENNETT has resigned as highway engineer of Bexar County, Texas, to become a member of the firm of Julian C. Feild & Company, consulting engineers, Denison, Tex. Mr. Bennett was associated with Julian C. Feild during 1910-11 in the building of the Denison road system. During his four years as highway engineer he built the Bexar County highway system at a cost of slightly over \$1,500,000, and since the completion of the road system has inaugurated a maintenance system for county roads.

F. H. FRANKLAND has become associated with the firm of Waddell & Son, consulting bridge engineers, of Kansas City, in charge of their recently opened branch office at 165 Broadway, New York City. Prior to his present position Mr. Frankland was engineer of bridges, Calcasieu Parish Highway Department, Lake Charles, La. He has had several years of general practice in civil engineering and four years of specialization in bridge designing and construction in New Zealand and Australia. He was educated in New York

and took a course in chemical engineering under his grandfather, Sir Edward Frankland, K.C.B., London.

T. H. GATLIN, assistant chief engineer maintenance of way and structures, has been made assistant to the vice-president of the Southern Railway lines.

B. HERMAN, until recently chief engineer maintenance of way and structures of the Southern Railway, with headquarters at Washington, D. C., has been appointed chief engineer maintenance of way and structures, Southern Railway, Lines East, with headquarters at Charlotte, N. C.

C. M. THOMPSON has been appointed division engineer, Colorado division of the Union Pacific, with headquarters at Denver, Col., vice George F. Davis.

C. M. RATCLIFF, assistant engineer of maintenance of the Southern Railway, at Washington, D. C., has been appointed office engineer of the Southern Railway System, with headquarters at Washington, D. C.

HUGH B. HOLMES, resident engineer of the Kansas City, Mexico & Orient Railway, has been appointed chief engineer, with headquarters at Kansas City, Mo.

J. D. CLAIR SMITH is successor to Tolman Engineering Co., Houston, Tex. He will continue the company's line of work, which is a general civil, mechanical and marine engineering practice. Mr. Smith, formerly of Hartington, Neb., was previously engaged in a general consulting-engineering practice.

J. T. COLLINS, formerly chief engineer, Department of Public Works, Santo Domingo, has been appointed general manager of the Dominican Government railroads by the head of the Military Department, Captain H. S. Knapp, U. S. Navy. Mr. Collins will have charge of construction, maintenance and operation of all railroads operated by the government of Santo Domingo.

E. WELDEN has resigned from the Thor Construction Company, of Cedar Falls, Iowa, and will engage in bridge contracting with the Welden Construction Company, Iowa Falls, Iowa.

ALFRED A. ANDERSON has resigned as assistant engineer with the Imperial Irrigation District, Calexico, Cal., to go with the California Railroad Commission at San Francisco.

CHARLES E. VAN VALKENBERG has been appointed city engineer of Fresno, Cal., to succeed B. E. Cronkite. Mr. Van Valkenberg was first deputy city engineer at the time of his appointment.

J. D. DAVIS, recently appointed representative of the Producers' Oil Company, has gone to Central America, Venezuela and Colombia to help develop the oil production of those coun-

tries. Mr. Davis was formerly on the Island of Trinidad, in charge of development of the oil industry.

S. A. JUBB, who has for several years been in charge of harbor construction work at Los Angeles, Cal., completes his work in that capacity on March 1.

B. E. CRONKITE has been transferred from the position of city engineer of Fresno, Cal., to the position of engineer in charge of sewer construction. He will have supervision of construction work on the \$500,000 storm and sanitary sewer systems, contracts for which were let by the city several months ago.

A. B. COLLINS has been appointed district engineer for Yakima county (Wash.) highways. Mr. Collins was graduated from the Colorado State Agricultural College in 1908 and was for two and one-half years in the Philippines with the Bureau of Lands as surveyor in charge of the Friar land computations. He was later engaged in the office of the City Engineer, North Yakima, Wash., and for two and one-half years was with Yakima county, Wash., on drainage work.

W. S. BARSTOW & COMPANY, INC., of New York, engineers and constructors, have opened an office in Sandusky, Ohio, in charge of C. B. Wilcox, who will also continue to represent the Barstow interests in Sandusky as chairman of the board of the Sandusky Gas & Electric Company. The Sandusky office will conduct a general engineering and constructing business along the lines pursued by W. S. Barstow & Company from their New York and Portland (Ore.) offices.

AMOS A. FRIES, major, Corps of Engineers, in charge of and stationed at Yellowstone Park, has been placed in charge of the river and harbor improvements in the First Portland (Ore.) District. This work, which is in addition to the work at the park, embraces all improvements on the upper Columbia and Snake rivers and all Oregon harbors on the Pacific Coast south of the Columbia River.

H. RAY KINGSLEY, engineer in charge of building engineering design for the Philippine government, is in Chicago, 1417 Railway Exchange, while enjoying an eleven-month vacation.

GEORGE F. BROWN has resigned as resident engineer for Black & Veatch, consulting engineers, Kansas City, Mo., to become assistant engineer with the Coventry Land & Improvement Company of Akron, Ohio. Mr. Brown has been with Black & Veatch since his graduation from the University of Michigan in 1913.

R. N. KELLOGG has been appointed city engineer of Coquille, Ore.

ERIC T. KING has been appointed assistant secretary of the General Contractors' Association, New York City. Mr. King, who is a graduate of Union

College, class of 1905, was for ten years assistant engineer on the Catskill water system for New York City, and latterly has been assistant to Lederle & Provost, consulting sanitary engineers, New York City.

JACOB L. CRANE, JR., who has been in the employ of Burns & McDonnell, consulting hydraulic and sanitary engineers, Kansas City, Mo., since his graduation from the University of Michigan in 1913, has just resigned his position in order to go with the Michigan State Board of Health as assistant engineer. He is at present engaged on a sanitary survey at Saginaw, Mich.

GEORGE L. KELLY is with the Heller Brothers Company, at Youngstown, Ohio, instead of Houston, Tex., as stated in the Feb. 3 issue.

CHARLES R. HENDERSON is circulating among the members of the American Water Works Association a post card bearing the following message: Dear Sir—My name has been placed on the ballot as candidate for President of the American Water Works Association without my knowledge or consent. Mr. Theodore A. Leisen of Detroit is the regular nominee, and I ask you to do all you can to secure his election. Sincerely, Charles R. Henderson. Davenport, Ia., Feb. 14, 1917.

T. N. GILMORE, chief engineer, Westinghouse Church Kerr & Company, has been elected second vice-president and chief engineer. He has been connected with the company for thirteen years.

R. C. KELLOGG has become associated with E. W. Bemis, consulting engineer, Chicago, on valuation of distribution system, Peoples Gas Light & Coke Company, Chicago. Mr. Kellogg has had ten years' experience in the distribution of gas. He was with the Consolidated Gas Company of New York for four years as designing draftsman and field engineer. Later he was for six years connected with the Brooklyn Union Gas Company, Brooklyn, as engineer and assistant to superintendent.

W. M. CARPENTER, until recently junior engineer on the staff of the Chicago Traction and Subway Commission, has been appointed engineer for the Charleston Interurban Railroad Company, with headquarters at Charleston, W. Va.

ALLEN & GARCIA Company, consulting and constructing engineers, Chicago, announce the establishment of a power department, which will be in charge of C. M. Garland, an expert in the different phases of steam and gas-power engineering. The electrical work in connection with this department will be handled, as at present, by W. C. Adams.

JOHN R. DOWNES, formerly chemist and manager of the sewer department, Plainfield, N. J., is now superintendent of the joint sewage-disposal works of Plainfield, North Plain-

field and Dunellen. Mr. Downes was educated at Rensselaer Polytechnic Institute. He then spent two years as chemist for the water-purification plant at Harrisburg, Pa., after which he went to Panama, where for 5 years he was physiologist in charge of sanitation of water supplies. He then returned to Plainfield.

OLIN ARNSPIGER has been appointed engineer and water superintendent of Medford, Ore.

R. S. CHARLES, engineer maintenance of way of the Detroit division of the Wabash Railroad, has been appointed to a similar post on the Peru division, headquarters at Peru, Ind. He is succeeded by W. K. Walker.

J. W. BURT, engineer maintenance of way of the Cleveland, Cincinnati, Chicago & St. Louis Railway, at Wabash, Ind., has been appointed engineer maintenance of way of the Chicago division at Indianapolis, vice R. Ferriday, resigned. C. W. Engle has been appointed engineer of maintenance of way of the Michigan division, vice Mr. Burt.

LOUIS YAGER has been appointed acting engineer maintenance of way of the Northern Pacific Railway, lines east of Paradise, Mont., with headquarters at St. Paul, Minn.

J. POWELL WEHRUNG has resigned his position as assistant city engineer, Amarillo, Tex., and has accepted the office of resident engineer, Childress, Tex., with Henry E. Elrod, Dallas.

EDWIN S. FULLER, of Los Angeles, formerly assistant engineer in the U. S. Geological Survey, has been retained by the Department of the Interior to prepare a special water-supply paper dealing with the determination of the stage-discharge relation for open channels. Mr. Fuller has made a special study of stream-flow problems during the last eight years, and has been engaged during the past season on intensive hydrometric work for the Twin Falls North Side Land & Water Company, at Jerome, Idaho.

MARTIN SCHACHT, contractor-architect, has opened offices in Portland, Ore. Mr. Schacht has been identified with both the designing and erection of many structures in and around Portland.

CHARLES BOONE has been appointed county engineer of Hancock County, Indiana. Mr. Boone was graduated from Purdue University in 1912 and has since been engaged in the contracting business in Iowa.

BERT W. MACY, whose name appeared in this section in the issue of Jan. 20 as city engineer of Salem, Ore., is attorney for that city. Walter Skelton is city engineer.

EARL B. SMITH, formerly associate mechanical engineer with the U. S. Office of Public Roads and Rural Engineering, Washington, D. C., in charge of physical research and concrete investigations, has been

transferred to the U. S. Bureau of Soils as mechanical engineer. Mr. Smith is a graduate of the University of Missouri, class of 1903. Since graduation he has been employed with the Wabash Railroad, Struthers-Wells Company, Philadelphia Rapid Transit Company and the Drexel Institute, Philadelphia, at which latter place he was assistant professor of experimental engineering for more than nine years. He has also carried on considerable private practice in commercial and industrial investigations. Mr. Smith's new duties will be along engineering lines in the design and construction of the new Government potash plant to be located at Summerland, Cal., where he, with Dr. Turrentine, scientist of the Department of Agriculture, will investigate the commercial possibilities of extracting potash, iodine, tar products, acetone, etc., from the kelps of the Pacific Coast.

JOSEPH H. EHLERS has left the service of the Delaware, Lackawanna & Western Railroad at Buffalo and entered the employ of the Bethlehem Steel Bridge Corporation at Steelton, Pa.

Obituary Notes

HOWARD A. GREENE, manager of erection, Pittsburgh division, American Bridge Company, Pittsburgh, Pa., died Feb. 2. Mr. Greene was born at Providence, R. I., Sept. 15, 1860. After his graduation from Brown University he was engaged in construction work in different sections of the country. This work included the location and construction of railroads, making of extensive surveys and the construction of terminal piers. From 1892 to 1901 he was assistant engineer for the New York district of the New Jersey Steel & Iron Company, where his last position was that of erection engineer. In July, 1901, he was appointed erection manager of the Pittsburgh division of the American Bridge Company, which position he held until the time of his death. While serving in this capacity he was in charge of the erection of many important structures, and was also the inventor of a number of important patented erection devices.

GEORGE HENRY HILL, assistant engineer of the railway and traction department of the General Electric Company, died Jan. 31 at his home in Schenectady, after a short illness. Mr. Hill was graduated from Johns Hopkins University in 1895, and early in his career as an engineer invented and patented the electric system for operating bulkhead doors on shipboard. Later he assisted in the development of the multiple unit system of train control. In connection with this work he produced the multiple-unit automatic system substantially as it exists to-day. During the past few years Mr. Hill had devoted considerable time to the electrification of steam railroads. ~

Gas-Engine Driven Unloader Is Portable

A portable unloader of the belt-conveyor type, originated for handling road materials by Allen Parrish, contractor, Paris, Ill., is shown herewith. It consists of a four-wheeled truck carrying a 6-hp. Novo engine driving an inclined belt, the lower end of which may be ex-



MACHINE WILL UNLOAD CAR IN 25 TO 40 MINUTES

tended under the car hopper. The extension is hinged so that it may be folded up, while the steep incline is hinged at the top so that the angle may be changed by raising or lowering the supporting chains. A car puller is part of the outfit, which can be set up, it is asserted, in two hours.

The unloader is manufactured by the Burrell & Tucker Engineering Company, Kankakee, Ill.

Machine Unloads Material at 75 Cents a Car

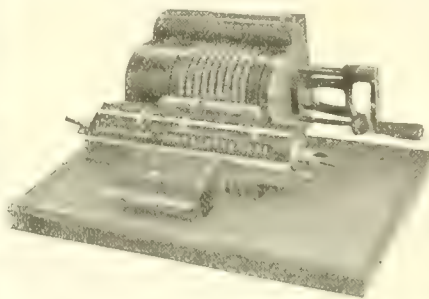
The automatic car unloader shown in the drawing is said to effect a great saving in cost of handling material. The manufacturer, the Sunbury Manufacturing Company, of Sunbury, Ohio, says it costs only 75 cents to unload a car of material with the Sunbury unloader. The device handles stone, gravel, sand, screenings and other loose material.

The depth of excavation below the rail to install this machine is 20 in. The heavy reciprocating feeder is built entirely of steel. It carries a certain amount of material forward and deposits it on a receiving section. With

the next stroke the material previously deposited is moved into the bucket elevator. The manufacturer declares that one man can operate the machine. No belt conveyor, hoisting skip or bucket is employed. A factor of safety of 2 has been used in the design.

Lightweight Calculating Machine Put on Market

A new lightweight calculating machine has just been put on the market by the Marchant Calculating Machine



NEW CALCULATING MACHINE IS LIGHT AND COMPACT

Company, Emeryville, Oakland, Cal. The so-called "Marchant Pony" is made in two sizes, one weighing 12 and the other 13 lb. One has thirteen digit places on the product or quotient dial, the other eighteen places. The smaller model sells for \$275, the larger \$325.

Business Notes

Central Creosoting Company of Chicago has purchased the plants and good will of the Chicago Creosoting Company.

Goulds Manufacturing Company of Seneca Falls, N. Y., manufacturer of pumps, has just made announcement of a bonus of an extra month's salary given to all employees. This includes all office employees both at the home office and branches, and all shop employees on the weekly and monthly basis. In November the company granted a wage increase of 10 per cent on all piece work.

Pacific Tank & Pipe Company has completed the first of the buildings of its new plant located on a 95-acre tract near the Melrose station of the Southern Pacific Railroad on San Francisco Bay. The plant is made up of four main buildings from 200 to 260 ft. long and 100 ft. wide.

Northwestern Steel & Iron Works, Eau Claire, Wis., has received another order for four mixers from the government of the United States, Panama Canal Division. Four No. 610 Northwestern mixers of 10 cu. ft. capacity were bought last May for work on the canal at Colon. The new machines, of the same size and capacity as the others, are to be used on the other end of the Canal Zone.

Trade Publications

The following companies have recently issued trade literature:

Foote Concrete Machinery Company, Chicago. Illustrated folder on Foote street-railway paving mixer.

Sauerman Brothers, Chicago. Catalog, 56 pages, describing power scrapers.

Wallace Supplies Manufacturing Company, Chicago. Catalog describing hand power bending tools.

Chicago Pneumatic Tool Company, Chicago. Folders on Duntley portable tools, hose, couplings and hose clamp tools.

G. H. Williams Company, Erie, Pa. Illustrated catalog, 48 pages, devoted to digging buckets.

Spray Engineering Company, Boston. Bulletin 250, describing Spraco equipment for washing and cooling air.

Gramm Bernstein Motor Truck Company, Lima, Ohio. Illustrated catalog, 30 pages, devoted to Gramm motor trucks.

Novo Engine Company, Lansing, Mich. Catalog 16, 80 pages, illustrated. Lists and shows Novo engines and outfits.

Niles - Bement - Pond Company, New York City. Condensed catalog, 48 pages, illustrated, listing machine tools.

American Sheet & Tin Plate Company, Pittsburgh. Catalog 120, relative to black and special sheets; 26 pages, illustrated.

NEW UNLOADER SAID TO REDUCE COST OF HANDLING MATERIAL

Submarines Fail to Cut Off Foreign Trade

Domestic Steel Production, However, Suffers, Estimates of Decrease in Output Ranging from 15 to 30 Per Cent—Great Jump in January Exports

SHOULD the German submarine warfare succeed in actually blockading England, Germany would be in a position to make her own terms, and there is no doubt that this country would be left face to face with an extremely serious situation. This contingency, of course, is growing more remote with the decreasing destruction of ocean tonnage reported each day. If, on the other hand, we are to understand that Germany doubted the effectiveness of such a campaign in the first place and desired to make the United States a party to peace negotiations, an early peace, favorable to the Entente Allies, should be prepared for, after which continued business activity in this country will depend to a great extent on our success in meeting the needs of foreign markets. For the present, however, it must be recognized that the temporary check administered during the first half of February to ocean freight movements from our Atlantic seaboard has prolonged the car shortage, hampered rail traffic, contributed to further rises in commodity prices and caused further curtailment of steel production. The decrease in the rate of the production of finished steel is variously estimated at from 15 to 30 per cent, as it is stated that the production of pig iron in the district dependent upon Connellsville coke, representing three-eighths of the furnace capacity of the country, has amounted to 60 per cent. Although orders appear to have declined slightly in volume since the first of the year, there is no prospect of any lessening of foreign demand for steel or any continued decrease in domestic consumption. Steel mills are sold far in advance, rails to be delivered in the last quarter of 1918 having been contracted for. Contractors and others purchasing steel for construction work still have to reckon with the probability of our own government entering the market for large quantities of war steel. Should this occur, it is evident that an increase rather than a reduction would be in order in the shipping of steel products to the Entente Allies, and that private domestic consumers would be the ones to have to do without steel. The construction field would undoubtedly be one of the first to feel the effects of such a situation.

A jump which is astonishing, even in view of the great recent growth of our export trade, occurred in the value of American exports for the month of January, which reached the figure of \$613,000,000. Exceeding as it does by 18 per cent the new record established in the preceding month,

this figure is surprising. In view of the recent reduction in ocean freight traffic it appears likely to stand as a record for a longer period than some of its predecessors.

Buildings

Building work noted in this issue includes the following projected construction:

	Kind	Cost
Wildwood, N. J.	Hotel	\$1,000,000
Chicago, Ill.	Gas plant	5,000,000
Milwaukee, Wis.	Warehouse	380,000
St. Paul, Minn.	Union depot	11,000,000
San Francisco, Cal.	Refinery	2,500,000
Toronto, Ont.	Munitions plant	3,000,000

Roads and Paving

Many coming elections are noted in this issue at which road construction involving large sums will be voted on. Among other proposed highway construction the following projects are noted:

	Kind	Cost
Bridgeport, Conn.	Street improvements	\$2,250,000
Pittsburgh, Pa.	Boulevard	900,000
Toledo, Ohio	Paving	1,000,000
De Ridder, La.	Highways	500,000
Crowley, La.	Bonds voted	400,000
Spencer, Iowa	Bonds sold	773,000
Oregon	Road improvements	1,800,000

Waterworks and Sewers

The lowest bid received for constructing a water-purification plant at Flint, Mich., was \$287,000. A contract for sewer construction to cost \$302,000 has been awarded at Portland, Ore. Plans have been completed at Springfield, Ill., for sewer construction to cost \$175,000. A high-pressure water main to be constructed for a new addition to the city of Detroit will cost \$1,500,000. Minneapolis has engaged a consulting engineer in connection with the construction of the new \$1,200,000 filtration plant. It is reported that Los Angeles will spend \$275,000 on sewage-disposal work.

Miscellaneous Headings

The date of opening bids for constructing the \$800,000 tunnel in Los Angeles has been changed to March 26. Railroad improvements to be made near Glenn's Run, W. Va., will cost \$1,000,000. A bill has been signed by the governor at Little Rock, Ark., creating a levee district authorized to issue \$1,200,000 bonds. A railway line to be built near Mitchell, S. D., will cost \$2,000,000. Irrigation work costing \$1,000,000 is under consideration at Medford, Ore. Plans have been prepared for railroad water-terminal improvements at San Francisco to cost \$2,000,000. The construction of a rock dike at a cost of \$1,125,000 is contemplated at Vallejo, Cal. The city of Los Angeles has applied for permission to construct a \$1,500,000 hydroelectric plant.

CONTRACTING NEWS

Of Special Interest to Engineers, Contractors, Builders and Manufacturers of Engineering and Building Supplies

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

in sections where no disposal plants exist, and will petition State Legislature for permission to construct and negotiate with each other for purpose of forming garbage and sewer districts.

Bayonne, N. J.—Walter L. Clarkson, city engr., to prepare plans for water plant; cost, about \$500,000.

Bloomfield, N. J.—Contracts will be let in March for c. i. pipe. Wm. R. Rawson, supt. waterworks. Ernest Baechlin, town engr.

Cliffside Park, N. J.—City planning sewer system; cost about \$25,000. McClave McClave, city engr.

Fanwood, N. J.—Fuller & McClintock, engr., have been engaged by Council to make surveys and estimates of cost for installation of sanitary sewer system, to connect with the Plainfield system.

Fords, N. J.—Morgan Larson, twp. engr., making surveys and estimates of cost for the installation of a complete sewerage system.

Mendham, N. J.—Boro. Clerk Leo Robinson writes that ordinance has not passed final reading; bids will not be received until April for proposed reservoir of 8,000,000 gal. capacity, 14,000 ft. 8-in. water pipe; cost about \$30,000. F. O. Pitney, engr., Morristown.

WATERWORKS AND SEWERAGE SYSTEMS

PROPOSED WORK

Barre, Vt.—City considering extending water system. Frank O. Lee, city engr.

Revere, Mass.—Town considers laying about 1 mile of water mains. Carl G. Richmond, supt. pub. wks.

Bridgeport, Conn.—See "Roads and Paving."

Torrington, Conn.—Reported trunk line sewers will be constructed this spring. C. A. Patterson, boro. engr.

Little Falls, N. Y.—City Engr. Geo. I. Oakley, in his annual report to Bd. Pub. Wks., recommends construction of either a large reservoir on Beaver Creek or a smaller reservoir above present city distribution reservoir.

Mineola, L. I., N. Y.—Various civic associations in Nassau Co., and officials from about 21 villages in county are discussing means of disposing of sewage and garbage

Linden, N. J.—Township Comm. contemplates building trunk sewer in St. George and the Greater Elizabeth sections; cost about \$75,000. Jacob L. Bauer, co. engr., Elizabeth.

Newark, N. J.—Following improvements planned at Port Newark Terminal: Sewers, \$155,000; tracks for railway line, \$120,000; bridge across Oak Island station of Lehigh Valley RR., \$200,000; bridge and approach at Port St., \$165,000; paving, \$130,000; dock, etc., \$155,000. Appropriation of \$500,000 will be asked of Legislature. Morris B. Sherrerd, ch. engr., Ed. Pub. Wks.

Perth Amboy, N. J.—See "Miscellaneous." Trenton, N. J.—City has sold \$10,000 bonds to be used for sewer improvements.

Athens, Pa.—Plans being prepared for sewer system; cost about \$35,000. R. R. Fernow, engr., 817 Weightman Bldg., Philadelphia. C. W. Tidd, boro. secy.

Kane, Pa.—Reported that construction of sewage disposal plant and additional sewers being considered. Roy S. Braden, city engr.

Marcus Hook, Pa.—Aston Water Co. plans extending its water system through Aston to Linwood Heights, including Upper Chichester Township. Company is a subsidiary of the Chester (Pa.) Water Co.

Norristown, Pa.—Boro. considering construction of storm and sanitary sewers. A. Cameron Corson, boro. engr.

Sharpsville, Pa.—Boro. reported considering construction of a joint sewage disposal plant for Sharon, Farrell and Sharpsville.

West Middlesex, Pa.—Election will be held Mar. 7 to vote on issuing \$10,000 bonds for constructing sewer system.

Ocean City, Md.—Question of constructing sewer system being considered; probable cost \$30,000.

Towson, Md.—Co. Comrs. considering construction of sewage disposal plant.

Altavista, Va.—Street, water and light bonds for \$16,000 will be sold Feb. 28 by W. S. Corbin, town clk.

Salem, Va.—Town will lay new water mains; cost about \$10,000. R. H. Bruce, resident engr.

Hinton, W. Va.—Reported city considers extending sewer system. J. B. Lavender, city engr.

Cairo, Ga.—City will call election Mar. 20 on question of issuing \$28,000 bonds to be used for construction of sewers.

Brooksville, Fla.—Reported waterworks bonds for \$20,000 will be sold Mar. 1. W. M. Russell, co. clk.

Miami, Fla.—City will call an election Mar. 20 on question of issuing \$150,000 bonds to be used for constructing sewer systems and sewage disposal plant.

New Smyrna, Fla.—City will vote \$10,000 bonds to be used for completing water works.

Bossier City, La.—City will call an election April 20 to vote on question of issuing \$30,000 bonds, to be used for waterworks.

Monroe, La.—See "Excavation, Drainage and Dredging."

Biloxi, Miss.—City considering purchase of new pump for pumping station, capacity 1,000 gal. per minute.

Pass Christian, Miss.—City will issue \$40,000 bonds to be used for construction of waterworks.

Owensboro, Ky.—Reported sewer improvements being considered this year. E. B. Shifley, city engr.

Bluffton, O.—Village will call election Mar. 6 to vote on question of issuing \$35,000 bonds to be used for improvements to water and light plants.

Dishler, O.—Bonds for \$33,000 for constructing municipal waterworks will be sold Mar. 13 by R. W. Hoskinson, clk.

Toledo, O.—Geo. W. Fuller, 170 Broadway, New York, is reported to be examining land for proposed changes at filtration plant and diverting sewage disposal from Ten Mile and Swan creeks. He will also look over plans for new system of sewage disposal nearly completed by Watson Harmon, asst. city engr.

West Jefferson, O.—Village has approved \$20,000 bond issue to be used for construction of waterworks.

Valparaiso, Ind.—Reported city considering construction of sewer system for west end; cost about \$28,000.

Detroit, Mich.—Theodore A. Leisen, supt. water comrs., estimates cost of 31 miles of 48-in. high-pressure water main to be installed this year in the new annexed city district at \$1,500,000.

Casey, Ill.—Plans being prepared for waterworks and pumping station to include 5½ miles of 8 to 10-in. c. i. pipe, steam power, pumps, etc.; cost about \$60,000. Miller & Holbrook, engr., Milliken Bldg., Decatur.

Mendota, Ill.—Plans being prepared for sewer system and septic tank to include 5½ miles of tile; cost about \$30,000. Wm. Weidner, city clk.

Springfield, Ill.—Wade Seeley, city engr., completed plans for extending town branch sewer; cost about \$175,000.

Iowa Falls, Ia.—City planning improvements for waterworks, including pumps, motors, wells, reservoir, etc. E. H. Marriage, city mgr.

Story City, Ia.—Plans being prepared for sewer system and disposal plant. J. Q. Williams, engr., City Hall, Ames, Ia. A. H. Williams, city clk.

Minneapolis, Minn.—City Council has engaged W. N. Jones, 1010 Bayless Ave., St. Paul, as consulting engr. for new filtration plant; cost about \$1,200,000.

Minneapolis, Minn.—Finance Comn. has asked City Council to approve issue of \$300,000 bonds for trunk line sewers.

St. Paul, Minn.—City Council considering construction of sewers in following streets: Palace, Bellows, Hyacinth, Charlton, Winona and Fillmore, Laurel Ave., etc.

Liberal, Kan.—City considering issue of \$19,000 bonds for waterworks improvements.

Fairfax, S. D.—Election will be held Feb. 28 on question of issuing \$40,000 bonds for construction of municipal waterworks.

Springfield, Mo.—City will call election in April on question of issuing \$45,000 bonds to be used for installation of outlet and septic tank.

Marvell, Ark.—Town has engaged U. S. Sanitary Septic Tank Co. (W. J. Kearney, gen. mgr.) as engineers for water and sewer system; cost about \$32,000.

Goliad, Tex.—Reported improvements to water and light plant being considered. E. F. Glaze interested.

Lockport, Tex.—Bonds for \$35,000 sold by city to be used for improvements and extension of sewer system.

Weimar, Tex.—Citizens have voted \$15,000 bonds for improving waterworks.

Weimar, Tex.—Bonds for \$15,000 have been voted by property owners for improvement of waterworks.

Wichita Falls, Tex.—Plans completed for water pipe line from Lake Wichita to the oil fields in Archer Co.; address Co. Judge.

Billings, Okla.—Plans being prepared for sewer system and extensions to waterworks. Election will soon be held to issue bonds.

Checotah, Okla.—City approved \$125,000 bond issue to be used for waterworks.

Okemah, Okla.—Election will soon be held on question of issuing \$50,000 bonds to be used for construction of sanitary sewer system.

Pendleton, Ore.—Contract will soon be let for constructing septic tanks to dispose of city's sewage; cost about \$10,000.

Brawley, Cal.—Bonds for \$17,000 for concrete basin and sludge sewer will be sold Mar. 19 by city. G. R. Wade, city engr.

Los Angeles, Cal.—City reported to be planning to spend \$275,000 on temporary work of sewage disposal at Hyperion.

Sacramento, Cal.—City Comm. considering an underground water system for domestic supply.

Nampa, Idaho.—City Engr. Ogden Dutcher has completed plans for the installation of a submain sewer system to serve the western side of city; cost about \$25,000.

Hull, Que.—J. P. La Forest, city engr., preparing plans for mechanical filtration plant to cost \$170,000. Contracts will be let about May 1.

Tecumseh, Ont.—Contract will soon be let, by R. W. Code, Bd. of Trade Bldg., Windsor, for 9,600 ft. 3-in. and 7,000 ft. 6-in. cast-iron water mains and fittings.

BIDS DESIRED

Atlantic City, N. J.—Until Mar. 8, by Bd. of Comrs. of B. Thomson, dir. parks and public property) for furnishing 61 tons c. i. pipe, 8 tons c. i. fittings; advertised in this issue.

Hawthorne, N. J.—Until Mar. 2 by Bd. Comrs. (John A. Shea, clk.) for construction and equipment of pumping station, small reservoir and pipe connections; plans may be obtained from J. W. De Yoe, boro. atty., 126 Market St., Paterson.

Island Heights, N. J.—Until Mar. 16 by Boro. Council (George S. McKaig, clk.) for constructing sewer extension and disposal plant. Louis A. Croxton, Mt. Ephraim, N. J., boro. engr.

Ogdensburg, N. J.—Until Mar. 15, by L. A. Sweeney, boro. atty., for constructing waterworks and 300,000-gal. capacity reservoir, Wm. N. Harris, boro. clk.; Jas. E. Rider, 29 Bway, New York, engr.; advertised in this issue.

Clifton Heights, Pa.—Until Mar. 1 by Boro. (Ernest Geiger, chmn., sewer committee) for constructing terra cotta pipe sewers. A. F. Damon, Jr., Post Office Bldg., Darby, Pa., engr.

Sumrall, Miss.—Reported desired until Feb. 27 by J. I. Brueck, city clk., for constructing water system; work includes pumps, steel tower, pipe, drains, etc. Xavier A. Kramer, engr., Magnolia.

Akron, O.—Until Mar. 5 (new date) by Dir. Pub. Serv., for erecting 2 water tube boilers, 300 hp. each, boilers to be installed in existing Cuyahoga River Pumping Station near Kent. G. Gale Difan, engr.

Leetonia, O.—Until Mar. 19, by J. S. McCue, village clk., for constructing sewage disposal plant and intercepting sewers; advertised in this issue.

Eldon, Ia.—Until Mar. 1, by City Council (H. E. Ritz, city clk.), for constructing sewer system consisting of pipe ranging from 10 to 18 in., together with manholes, catch basins, etc., advertised in this issue.

Knoxville, Ia.—Until Feb. 27 by Paul M. Black, city clk., for constructing 31,870 ft. of from 6 to 12-in. sewers; also for sewage disposal plant. M. G. Hall, engr., Centerville.

West Burlington, Ia.—Reported desired until Mar. 5, by W. J. Giesel, man. clk., for constructing storm water sewer and waterworks improvements; cost about \$70,000. Stevens & Stiles, engr., 708 Ridge Arcade, Kansas City, Mo.

Gering, Neb.—Reported desired until Feb. 27 by S. L. Irvine, city clk., for constructing lateral sewer system; cost about \$23,280; certified check for \$500 to accompany bid.

Omaha, Neb.—Reported desired until Feb. 28 (extension of time), by Metropolitan Water Dist. (R. H. Howell, gen. mgr.) for constructing 30,000,000-gal. high service pumping unit at Florence Station.

Grand Forks City, N. D.—Until Mar. 15 by W. H. Alexander, city aud., for metering of effluent, improving and repairing existing waterworks, filtration plant.

Mitchell, S. D.—Until about Apr. 1, by city for constructing 4½ mi. sewers and sewage treatment plant; Dakota Eng. Co.; Mitchell, engr.

Wessington Springs, S. D.—Until about Apr. 1, for constructing 5½ mi. sewers and sewage treatment plant; Dakota Eng. Co., Mitchell, engr.

PRICES AND LETTINGS

★Indicates award of contract.

Brooklyn, N. Y.—Following are 4 lowest bids received at office of boro. pres. for constructing sewers in portions of Ocean Ave.—(a) section 1, and (b) section 2: Concrete Material Co. (J. J. Creem, pres., 688A Greene Ave., Brooklyn), (a) \$287,464 (lowest on 1st section), (b) \$320,150; Newman & Carey Subway Contr. Co., 1228 Nostrand Ave., Brooklyn, (a) \$328,421, (b) \$255,101 (lowest on sect. 2); Jaret Chambers & Co., 30 E. 42d St., (a) \$376,393; Ward & Tully, Inc., 10th Ave., Brooklyn, (a) \$392,261; Jas. O'Leary, 411 E. 42d St., New York, (b) \$292,507; Jos. J. B. La Marsh, Inc., 1771 Pacific St., Brooklyn, (b) \$332,466. Engr's estimate on (a) \$369,013, (b) \$336,990. Edwin J. Fort, ch. engr., bureau sewers.

Philadelphia, Pa.—Following bids opened by Bd. Pub. Wks., Feb. 16, on c. i. water pipe, per ton, U. S. C. I. Pipe Co., 71 B'way, New York, and Donaldson Iron Co., 1 B'way, New York, \$50; R. D. Wood Co., 400 Chestnut St., Philadelphia, \$59.44, and on pump impeller castings, 17½ cents per lb.; on mechanical stokers, Cox & Traveling Grate Co., Hazleton, \$26,400; Leigh Stoker Co., Fullerton, \$35,000.

Reading, Pa.—Contract awarded for water meters covering 1917 requirements to Badger Meter Mfg. Co., Milwaukee, Wis.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MCGRAW PUBLISHING COMPANY, INC.

Volume 75

NEW YORK, SATURDAY, MARCH 3, 1917

Number 9

Engineering Record and Engineering News Consolidate

*Engineering Record and Engineering News will be
consolidated April 5th as the Engineering News-Record*

WE FIND it hard in making this announcement to refrain from the use of superlatives. Both papers have had such remarkable careers, both have built up such strong clienteles, both have to their credit so many achievements, that the imagination is fired at the thought of what they are capable of doing when their prestige, their staffs, their energies are combined.

For years both have been developing rapidly, and as they developed, their conceptions of the journalistic needs of the civil engineer and the contractor have come closer together and are now practically identical. Consequently, there has been much duplication—in material published and in the organizations to produce the papers. Moreover, each paper has excelled in certain special fields, due to the abilities of the specialists on the respective staffs.

Now it is proposed to give the readers under one cover the strong features of both papers and to turn the duplicated efforts into productive lines. Mr. Charles Whiting Baker, for twenty-one years editor of Engineering News, will be editor-in-chief, while Mr. E. J. Mehren, editor of the Engineering Record, will become vice-president and general manager of the McGraw-Hill Publishing Company, Inc., which has been organized to take over the ten publications of the McGraw Publishing Company, Inc., and of the Hill Publishing Company.

We bespeak for the new journal the same hearty support that has been accorded to the two constituent papers, and on behalf of the editors we pledge a service to the civil engineer and the contractor entirely unprecedented in technical journalism. And we give this pledge with the greater confidence because our publishing experience tells us that never before has there been brought together so able and brilliant a staff as that which will man the new journal.

JAMES H. MCGRAW
President, MCGRAW PUBLISHING COMPANY, INC.

ARTHUR J. BALDWIN
President, HILL PUBLISHING COMPANY

Engineering News-Record Consolidation

THE IMPORTANCE of the announcement on the preceding page, of the consolidation of the Engineering Record and Engineering News, need not be emphasized for the readers of this journal. The two papers have for so long been the leaders in their field, have played so great a part in the development of the civil engineering art that the event is of first importance to all civil engineers and contractors.

While the step is momentous, it comes logically. For years, Engineering News covered broadly the whole field of engineering, while the Engineering Record, until as late as five years ago, devoted much space to heating, ventilating and power plants for buildings. Both journals have found it necessary in recent years to confine themselves to civil engineering and contracting. Moreover, their analyses, made independently, of what the civil engineer and the contractor want have led to the same conclusions. As a result, what differences there were in editorial policy have almost wholly disappeared. There has been much duplication in material and in the machinery for gathering data from the engineering field. Then again, the staffs have developed strength in certain directions: In some specialties Engineering News has excelled, in others the Engineering Record.

By combining the two papers the waste will be stopped, the efforts now spent in duplicate service will be turned into original lines and there will be put into one magazine all the strength which the specialists on either staff have contributed to their respective papers. *The result will be a service to the engineer and the contractor which neither paper alone could furnish.*

Both papers have had plans for expansion in certain directions, for more intensive specialization in others. Financial limitations prevented these plans from being put into effect in all their fullness. Now, with the strength derived from the consolidation, the editors can go forward with speed in the development of these plans. *Their ideal is nothing short of a paper that will*

fill every need that can be legitimately served by a technical journal.

The editors are not unmindful of the tremendous responsibility which the publication of such a journal will impose. With a circulation of approximately 35,000 they will reach each week between 75,000 and 100,000 civil engineers and contractors. To be allowed to speak to them weekly, to present analyses of important developments, to give them broad views on public questions, to fight their battles, to lead ever upward, to hearten them in their efforts to develop a professional consciousness, is a great privilege. At the same time this very privilege, this opportunity, imposes the grave responsibility of being ever on the alert to sense first and to record matters of importance to the profession, and of looking fearlessly at all situations, championing what is best for the engineer and the contractor, no matter what the cost.

We cannot close these comments without expressing to you, the readers of the Engineering Record, our thanks for your support and our confidence in your continued interest. You have been most kind to us during our period of developing the Engineering Record. You have commended the changes which you believed were for the better. You have constructively criticised when our course did not meet your approval.

Soon, the Engineering Record's career of forty years as a separate journal will close. We who have lived our lives into it would witness its going with regret did we not realize the brighter future ahead. We see it, consolidated with Engineering News, rendering a still greater service to the field, striking more telling blows for the advancement of its clientele and for the public good. We know, too, that its spirit—the spirit of optimism, of faith in the ultimate leadership of the engineering profession—will not pass, but will be more striking, more virile in the larger paper.

The Engineering Record is not to die. It is to enter on a greater career.

Michigan's Motor-Truck Bill

THE bill "to regulate the operation and use of vehicles on the highways," now before the Michigan legislature and summarized by D. A. Thomas on page 343 of this issue, is unusual, as compared with similar measures in other states, in that it does not single out the motor truck as the sole agency responsible for damage to roads. Among the offenders it recognizes the horse-drawn vehicle. Whether it will pass in its present form remains to be seen. Any measure which carries with it even a hint of alienating the farmer vote can generally be counted upon to create panic among the Solons in our state capitols. Nevertheless, if sound engineering principles are to govern a decision as to the responsibility for highway wear, and payment there-

for, there is no logical reason for excluding the horse-drawn vehicle from regulation and tax. In the recently passed New York State schedule of motor-truck fees, this issue was very studiously avoided. The motor-truck interests maintain—and maintain justly, in the opinion of this journal—that any measure which fails to recognize the principle of equal obligation on the part of motor-driven and horse-driven vehicles is discriminatory. Will the Michigan legislators enact the present bill into law? The measure contains a number of good features and represents progress in framing documents of this sort. Highway engineers and motor-truck owners and manufacturers will follow its course through the legislative channels with a good deal of interest.

Protecting Soft Roads

ANOTHER feature of the Michigan motor truck bill which should be noted by highway engineers is the section designed to protect country highways during the period when they are most vulnerable to the attack of traffic—during the months of March, April and May, when the frost is thawing out or when rains make the road surfaces exceedingly soft. The Michigan measure stipulates that during such periods the maximum carrying capacity of all vehicles—and this includes horse-drawn as well as motor-driven—shall be reduced to one-half of the amount ordinarily allowed. Presumably the decision as to when a road is too soft to carry fully loaded vehicles rests with local highway officials, who are empowered to post notices along the road for the information of vehicle owners. An infraction of this rule subjects the guilty party to fine or imprisonment. Every highway engineer knows that a heavily loaded truck traversing a soft road in early spring can do more damage in a single trip than would be possible if a whole fleet of trucks used the road regularly, day in and day out, when it was hard. In this section, the Michigan bill touches upon a matter of vital importance, especially where rural roads are concerned. On the whole, the bill gives evidence of intelligent study, and engineers elsewhere will do well to digest its contents thoroughly.

Employ the Right Engineer

EVIDENCES of the fact that Texas municipalities are seeking the solution to their sewage-disposal problems are appearing in all parts of the state. Not only has the state enacted an anti-stream-pollution law and intrusted the State Board of Health with its enforcement, but several Texas cities have already begun the construction of modern sewage-treatment works and many others are contemplating similar action. Commenting upon this condition of affairs before a recent meeting of the League of Texas Municipalities, Charles Saville, state director of public health, gave some sound advice to municipal officials responsible for the construction or maintenance of sanitary works. The following extract from his address should be part of the creed of every city official vested with the power of appointment: "Employ a hydraulic engineer experienced in the design of sewers and sewage-treatment works. In choosing this engineer, do not make the mistake of giving undue consideration to a local man or to one whose fee is low. It is not to be expected that a surveyor or a railroad man can produce the best results on a sewage-disposal project. Furthermore, an experienced man, by his knowledge of this special branch of engineering, will make savings for your city, both in the construction and operation of the works, amounting to many times his fee." This advice is not new, but it must be repeated again and again if cities, embarking on sanitary engineering projects, are to get value received for the money they expend.

Clouds of Dust

IT IS A PITY that our governmental system permits a few persons who have axes to grind, or who are misled by those who have, to stand in the way of public improvements. Manhattan Island, in New York City, is sadly in need of modern rail freight terminals, the tracks to which shall not conflict with vehicular traffic by occupying city streets. The only railroad which has rail freight terminals on this island does not possess enough track space, traverses and obstructs city streets and a large waterfront, and defaces city park property by passing along or through it in the open. The city and the railroad have long been attempting to get together on a plan for remedying the whole situation. But the average man does not investigate. He takes other people's word for things and is easily misled by falsehood. Armed with this knowledge, various groups in New York City, backed by certain newspapers usually to be found on the obstructionist side, have waged a campaign against this improvement which is fast obscuring the entire matter in a cloud of dust.

When engineers have realized the possibilities that lie in educating the public to see the economic soundness of engineering solutions worked out for problems such as this, disheartening exhibitions of the kind now being staged in New York will be more rare. Then no newspaper will dare print distorted news about an engineering undertaking, nor even the half truths emanating from zealous but misguided persons who can see only one feature of the plan. The New York Central Railroad has made a start in the direction of telling the public about the proposed plan. It has kept on display for months in its Grand Central Terminal a model of a large part of the proposed improvement. This model, however, should not merely have been displayed. It should have been placed in the center of the concourse—thrust upon the public. Then, perhaps, the pettifoggers' would not have felt quite so certain of misleading the public.

The engineers of every city are deeply concerned with such improvements. Those of New York owe it to the public to speak out even more frequently and plainly than they have in this case. They alone can convince the public that engineers are not the hired draftsmen and surveyors of wicked capitalists, but the students of public needs and the creators of public works to serve those needs. With real-estate associations, societies to prevent Father Knickerbocker from spending any of his money, and amalgamations of sentimental bush-preservers bringing court actions and filling the air with outcries, have not the engineers of New York City a right to take a hand in this case, investigate it from the public point of view and present it to the city in its true light? Engineers connected with the city and with the railroad company have already done this, and their findings have naturally been assailed on the ground of partiality. Such an attack could not be made on the findings of a number of men appointed, for instance, by the Engineers' Club.

Filters Run Longer When Aëration Reduces Free Carbonic Acid

Tests at Panama Canal Water-Purification Plants Show Operating Costs Can Be Lowered by Changing Point of Alum Application

By GEORGE C. BUNKER

Physiologist in Charge of Canal Zone Water Purification

PERIODS of filter service have been more than doubled and wash-water requirements practically halved by reducing the amount of free carbonic acid in the water applied to the rapid sand plants of the Panama Canal Zone. This result has been achieved merely by changing the point of application of the coagulant solution of alum, making the alum treatment precede, instead of follow, aëration by means of spray nozzles. The first tests to free the settled water from carbonic acid were made with lime alone at the Agua Clara plant, and the aëration experiments were later undertaken at the Mount Hope plant to cut down on the amount of lime used. In a comparison of runs of a week's duration under the old and the new methods of operation the following economies were effected: Average length of filter runs increased from 19.5 to 45.9 hours; 513,000 gal. of wash water saved; number of filter washings reduced from 27 to 13; running time of two air compressors lowered from 35.8 to 18.3 hours.

FACTORS AFFECTING FILTER SERVICE

The variation in the length of filter runs is, to the writer, one of the most interesting features of the operation of rapid sand filters. For some time a study of the factors which might exert an influence has been carried on, and while uncompleted, certain facts in regard to free carbonic acid are of sufficient importance to be published at this time. It is realized that the amount of free carbonic acid in the water applied to the filters is not the only factor which determines the length of the runs. The numbers of micro-organisms and the amounts of amorphous matter and aluminium hydrate are all intimately associated with the rate of increase of loss of head.

AGUA CLARA PURIFICATION PLANT

The Agua Clara plant, in operation since Dec. 29, 1911, supplies filtered water to the Gatun district. It comprises the following units: Mixing chamber, sedimentation basin, rapid sand filters and clear-water basin.

Mixing Chamber—The reinforced-concrete mixing chamber measures 5 x 30.5 ft. in plan. Eight vertical baffles, forming alternate submerged and overfall weirs, insure a thorough mixing of the raw water with the alum solution.

Sedimentation Basin—This basin measures 70.5 x 71 ft. in plan by 10.5 ft. in depth. Its capacity is 350,000 gal. A pressure wall separates it into two divisions of equal size, thus forming two basins which are operated in parallel. Each division is further subdivided by a baffle-wall into two compartments, each of which measures 35 x 35 ft. in plan. At the filter-building end of the basins the settled water enters a receiving box from which it passes upon the filters.

Rapid Sand Filters—There are four rapid sand gravity filters, constructed of reinforced concrete, measuring 17 ft. square by 9 ft. deep to the floor on which the underdrainage system is placed. They are arranged in two rows of two units each, with the operating floor and pipe gallery between. Each unit has a sand area of 279 sq. ft., or 0.0066 acre. If operated at a rate of 98,000,000 gal. per acre per day, each unit will deliver 646,000 gal. per 24 hours.

Embedded in the floor is an underdrainage system of the Harrisburg (Pa.) type, composed of parallel 2-in. galvanized pipes, 4 ft. long, spaced 6 in. apart, center to center, and perforated on the under sides with holes 7/32 in. in diameter, which are spaced on 3-in. centers. A 4-in. air line is tapped into each of the two manifolds. In each filter there are 24 in. of graded Chagres river gravel and 30 in. of Chame beach sand, with an average effective size and uniformity coefficient of 0.44 and 1.81 respectively.

In washing the filters air is applied for about 5 minutes and then water at the rate of 3800 gal. per minute, or 13 gal. per square foot of sand surface, equivalent to a 21-in. vertical rise per minute. The wash water is removed by two parallel concrete troughs.

Clear Water Basin—The clear-water basin is located a short distance from the filter building and has a capacity of 157,000 gal.

TREATMENT OF WATER

In the early part of 1916 the application of soda ash to the raw water, derived from an impounded reservoir, was started in order to increase the residual alkalinity of the filtered water. The proportion of alum-reactive alkalinity in the raw water has steadily diminished since the start of the plant in 1911. During the latter part of 1915 the use of a settled water of zero alkalinity and, at times, an alum acidity caused a shortening of the filter runs to about 4 hours, a cementing together of the sand, with the formation of hard spots in the filters, a marked corrosive action on service pipes and a harmful physiological effect.

After an experimental period, during which soda ash and lime were applied to the raw and settled water at different points, the best results were obtained by applying a saturated solution of lime water to the settled water as it passed into the second half of the sedimentation basins. It was immediately noticed that, with an increase of alkalinity and an accompanying decrease in free carbonic acid, the length of the filter runs increased and the hard spots gradually disappeared.

Due to the various changes in piping, the installation of short circuiting baffles and a lime-feeding apparatus and various repairs incidental to the improved operation of the plant, the continuous reduction of free carbonic acid in the settled water to a desirable minimum

has been practically impossible. In addition variations in the strength of unslaked lime, which is shipped to the Canal Zone in steel drums, render an even treatment of the water difficult.

CARBONIC ACID SHORTENS RUNS

The following table shows the rapid jumps in loss of head during a typical short run as a result of applying to the filter a settled water containing 8 parts of free carbonic acid:

Hour	Loss of head, feet
7.00 a.m.	0.7 (initial)
8.00 a.m.	2.0
9.00 a.m.	4.6
9.40 a.m.	7.6 (final)

After a short run of this kind, when a filter is drained down to within a few inches of the sand, a large amount of air is liberated from the filtering material if a rake

liberated by the formation of aluminium hydrate, by aëration of the raw water after the addition of the alum solution. An experimental aëerator, built of wood and patterned after those in use at South Norwalk, Conn., was built over the inlet end of the mixing chamber. It measured 4 x 8 ft. in plan by 4 ft. deep. The bottom was perforated by $\frac{1}{4}$ -in. holes spaced on 1-in. centers and was raised above the top of the mixing chamber so as to give a fall of 4 ft. to the water flowing through it. A temporary bypass from the raw-water main brought the water up to the top of the box, where it was discharged into a trough, from which it splashed over and down to the perforated bottom.

The solution of alum was applied to the raw water just before it entered the box, so that the liberation of the free carbonic acid, due to the formation of aluminium hydrate, was effected before the water passed out through the bottom of the box. Tests made by the writer indicated that this aëerator would not remove



MOUNT HOPE RAPID FILTER PLANT AT CANAL ZONE, SHOWING POINTS AT WHICH ALUM WAS APPLIED

or pole is pushed down into it or even drawn through the surface layer of sand.

The influence of the amount of free carbonic acid in the settled water applied to a filter is well illustrated in the following case: A filter was placed in service at 7 a. m. with an initial loss of head of 0.8 ft., which increased to 2.3 ft. at 11 a. m. At this time the free carbonic acid in the water on top of the filter was 3.5 parts per million. The amount of lime solution applied to the settled water was increased. At 3 p. m. the loss of head had reached 6.8 ft., but at 4 p. m. it had dropped back to 4.5 ft. and the water on top of the filter was neutral to phenolphthalein. If the free carbonic acid in the settled water had been allowed to remain at 3.5 parts per million, the length of the run would have been 9 hours, but by increasing the lime, rendering the water neutral or slightly alkaline and removing the accumulation of gas in the filtering material, it was increased to 17 hours.

With the free carbonic acid in the settled water averaging 1.0 part, a run of 52 hours has been obtained. With the lime cut out, as has happened several times due to a shortage, the length of the runs immediately decreased to a minimum of 3 hours.

In order to reduce the amount of lime, the writer decided to try to remove part of the free carbonic acid,

more than 50 per cent of the free carbonic acid added to the water by the alum, which left, under present conditions of operation, about 7 parts to be removed by lime treatment. In order to determine whether or not more effective decarbonation would result by spraying the water through the air by means of nozzles, further experiments were carried on at the Mount Hope purification plant.

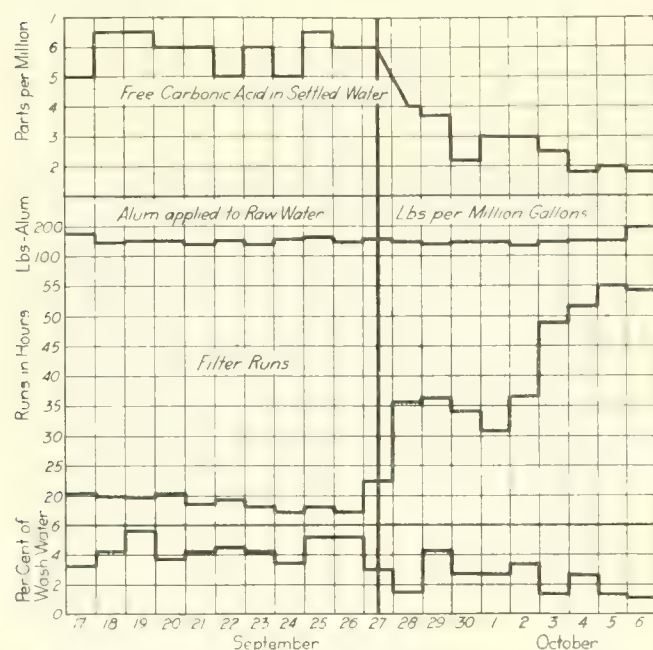
MOUNT HOPE PURIFICATION PLANT

The Mount Hope plant, in operation since Feb. 23, 1914, supplies filtered water to that portion of the northern district which lies north of and includes Mount Hope, Colon, Cristobal and Margarita Point, with a combined population of about 37,000. It comprises the following units: Aëration basin, sedimentation basin, rapid sand filters and clear-water basin.

Aëration Basin—This basin, measuring 60 x 66 ft. in plan, is equipped with 85 cone nozzles, which are arranged in five batteries of 17 each. The nozzles are so adjusted that, under ordinary operating conditions, the raw water is discharged at an angle of 30 deg. in a thin sheet which breaks up into fine drops. The average diameter of the circle which is formed by the discharge of one nozzle striking the floor is 24 ft. The average loss of head due to the nozzle itself is 1.95 ft.

Mixing Chamber—From the aëration basin the raw water flows through three parallel mixing chambers in which vertical baffles, forming alternate submerged and overfall weirs, insure a thorough mixing of the raw water with the alum solution.

Sedimentation Basin—From the mixing chambers the alum-treated water flows into three cross-connected parallel concrete sedimentation basins, with a total capacity of 2,500,000 gal. The length of each basin is 171 ft., the combined width of the three is the same, the depth at the floor valleys is 13 ft. 6 in. and that at the summits 12 ft. 3 in. Each basin is divided into three compartments, 56 ft. 8 in. square, by two pressure walls, which are provided with four rectangular openings, 1 ft. wide by 4 ft. long, placed 3.5 ft. below the water level. Extending across these baffle walls in front of the openings are concrete skimming troughs which reach to within about a foot of the normal water level. Between the pressure walls there is a light baffle wall in



BY MAKING ALUM TREATMENT PRECEDE INSTEAD OF FOLLOW AERATION FREE CARBONIC ACID WAS REMOVED AND FILTER RUNS LENGTHENED—CHANGE IN OPERATION METHODS WAS MADE SEPTEMBER 27

each compartment which extends from one side to within 6.5 ft. of the opposite side.

Rapid Sand Filters—There are six rapid sand gravity filters, constructed of reinforced concrete, measuring 27.5 x 18.66 ft. and 10.25 ft. deep to the floor on which the underdrainage system is placed. They are arranged in two rows of three units each, with the operating floor and pipe gallery between. Each unit has a sand area of 513 sq. ft., or 0.1178 acre. Operated at the present rate of 104,200,000 gal. per acre per day each unit delivers 1,226,000 gal. per 24 hours. Embedded in the floor is an underdrainage system of the Harrisburg (Pa.) type, identical in detail with that described under the Agua Clara plant. Each of the two manifolds is tapped with a 4-in. air line. In each filter there are 22 in. of graded Chagres River gravel and 30 in. of Chame beach sand, with an average effective size and uniformity coefficient of 0.41 and 1.70, respectively.

In washing the filters, air is applied for a period of

4 to 5 minutes, followed by water at the rate of 5900 to 6000 gal. per minute, or 11.1 gal. per square foot of sand surface, equivalent to a 17.5 in. vertical rise per minute. The wash water is removed by one central and eight lateral concrete troughs.

Clear-Water Basin—This is located under the filter building and has a capacity of 520,000 gal.

CHANGE IN OPERATION

After the relation between the amount of free carbonic acid in the settled water and the length of the filter runs had been observed at the Agua Clara plant the writer made the necessary changes to apply the alum to the raw water before the latter was discharged through the nozzles in the aëration basin. Table 1 contains the data from which the accompanying curves were plotted. They show the reduction in free carbonic acid in the settled water after this change was made at 1.30 p. m., Sept. 27, with the resulting increase in the length of the filter runs and decrease in amount of wash water.

During the first few days following Sept. 27 part of the alum was added to the water after it had been aërated, so that the maximum reduction of the free carbonic acid was not effected until the latter part of the period covered by the curves. Some time was also required to displace the 2,500,000 gal. of water in the sedimentation basin with an equal amount containing about 2 parts per million of free carbonic acid. The runs immediately started to lengthen as the free carbonic acid decreased. From Oct. 3 to 7 inclusive the average amount of free carbonic acid in the settled water was maintained close to 2 parts per million, with the result that the runs increased to an average of 52 hours. The shortest run for any one filter during the 10 days prior to the change in treatment was 17.3 hours; the longest run during the nine days following the change was 59.6 hours.

AERATION REMOVES CARBONIC ACID

During the latter part of the period the amount of alum added to the raw water was varied so as to add 4.9, 7.5 and 12 parts per million of free carbonic acid by means of the formation of aluminium hydrate. Samples of the aërated water collected at suitable intervals contained 2 parts per million, the original amount present in the raw water before the addition of any alum,

TABLE 1—HOW FILTER RUNS WERE INCREASED AFTER OPERATION WAS CHANGED ON SEPT. 27 SO AS TO MAKE AERATION FOLLOW INSTEAD OF PRECEDE ALUM TREATMENT

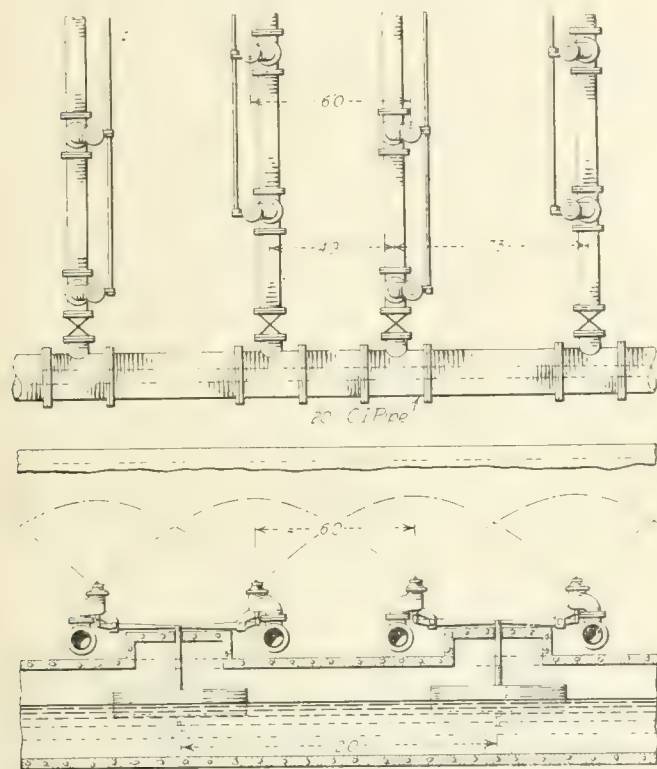
Date, 1916	Free carbonic acid in settled water, p.p.m.	Filter runs, hours	Alum, lb. per 1,000,000 gal.	Per Cent of wash water
Sept. 17.....	5.0	20.4	176	3.2
Sept. 18.....	6.5	20.0	140	4.2
Sept. 19.....	6.5	19.8	144	5.6
Sept. 20.....	6.0	20.3	143	3.7
Sept. 21.....	6.0	18.6	136	4.3
Sept. 22.....	5.0	19.3	150	4.5
Sept. 23.....	6.0	18.2	137	4.2
Sept. 24.....	5.0	17.3	156	3.4
Sept. 25.....	6.5	18.1	161	5.2
Sept. 26.....	6.0	17.4	147	5.2
Sept. 27.....	6.0	22.5	152	3.0
Sept. 28.....	4.0	35.6	144	1.5
Sept. 29.....	3.7	36.3	140	4.2
Sept. 30.....	2.2	33.8	142	2.7
Oct. 1.....	3.0	30.4	142	2.7
Oct. 2.....	3.0	36.7	134	3.4
Oct. 3.....	2.5	48.7	146	1.3
Oct. 4.....	1.8	51.5	150	2.6
Oct. 5.....	2.0	55.0	149	1.4
Oct. 6.....	1.8	54.5	196	1.3

showing that all the free carbonic acid which was liberated by the addition of the maximum amount of alum was removed by the method of aëration in use.

The physical and chemical characteristics of the raw and filtered water remained practically the same before and after the change in the point of application of the alum. The number of micro-organisms and amount of amorphous matter in the raw water did not show any notable variation.

Table 2 contains comparative data for the weeks ending Sept. 23 and Oct. 7.

It may be seen that 513,000 gal. of wash water was saved and the per cent reduced from 4.22 to 2.36; the filter runs were increased from an average of 19.5 to 45.9 hours; the free carbonic acid in the settled water was reduced from 5.9 to 2.3 parts; the number of filter



AERATING NOZZLES AT MOUNT HOPE PLANT

washings was reduced from 27 to 13; and the running of two air compressors was reduced from 35.8 to 18.3 hours. The physical and chemical characteristics of the filtered water remained the same.

During the last six months of the fiscal year ended

TABLE 2—COMPARATIVE DATA ON OPERATION FOR WEEKS ENDING SEPT. 23 AND OCT. 7

Data	Week ending Sept. 23, 1916	Oct. 7, 1916
Water, filtered, gallons.....	27,729,000	27,806,000
Wash water, gallons.....	1,169,000	656,000
Per cent of wash water.....	4.22	2.36
Pounds of alum per million gallons.....	147	152
Filter runs in hours:		
Average.....	19.5	45.9
Maximum.....	23.0	59.6
Minimum.....	15.2	28.0
Free carbonic acid, parts per million:		
Settled water:		
Average.....	5.9	2.3
Maximum.....	6.5	3.0
Minimum.....	5.0	1.8
Raw water:		
Average.....	2.8	1.9
Maximum.....	3.5	2.5
Minimum.....	2.0	1.5
Number of filters washed.....	27	13
Air compressors, total length of runs, hours	35.8	18.3

June 30, 1916, the monthly averages of the filter runs varied from 12.3 to 19.9 hours; the number of filter washings varied from 118 to 195 per month; the monthly volumes of wash water varied from 5.7 to 10,500,000 gal.; and the monthly percentages of wash water varied from 4.45 to 8.28. Comparing these figures with those in the tables, the writer expects to make a reduction of about 4,000,000 gal. in the monthly amount of wash water consumed at the Mount Hope purification plant by removing the free carbonic acid which is liberated in the formation of aluminium hydrate. In addition to the saving effected through this decrease in the wash water, the cost of the operation of the air compressors will be reduced about 45 per cent.

The writer desires to acknowledge the assistance received from Theodore R. Kendall and Harry T. Campion, resident chemists at the Agua Clara and Mount Hope purification plants.

Investigation of Slag as Aggregate for Concrete

Strengths Averaging 50 Per Cent Higher Than Gravel Concrete at 28 Days Were Obtained—Requires 15 Per Cent More Cement

THE RELATIVELY high strength of slag concrete is well known, but few tests have been made to compare the relative value of different slags and to study comprehensively the various qualities. Such an investigation and tests, described in a paper presented before the annual meeting of the American Concrete Institute by Sanford E. Thompson, consulting engineer, of Boston, are taken by permission from a report made by the author to the Stone & Webster Engineering Corporation for the purpose of determining the availability of slag as an aggregate for plain and reinforced concrete. Several series of tests were undertaken, and conclusions are drawn from these tests and from a study of previous investigations.

CONCLUSIONS RESULTING FROM TESTS

As a result of the tests the following conclusions have been reached:

1. The strength of concrete made with slag, such as is obtainable commercially in eastern and northern Ohio, was on the average about 50 per cent higher at the age of 28 days than gravel concrete made with first-class materials.
2. Using the same proportions by volume as for gravel concrete, about 15 per cent more cement on the average was required per cubic yard for slag concrete than for gravel concrete of the same proportions.
3. No authentic cases of deterioration of slag concrete made with Portland cement or of rusting of steel embedded in such concrete have been discovered.
4. Porous slag produced a concrete of substantially the same strength at 28 days as dense slag. At later ages the dense slag is probably stronger.
5. Slag made by different processes and under different conditions showed no marked difference in strength and other characteristics.
6. An extremely hard, dense, acid slag did not produce a concrete of greater strength than porous, basic slag on a 28-day test.

7. The weight of the slag concrete tested averaged about 6 per cent lighter than an average gravel concrete. On the other hand, very dense acid slag concrete was heavier than gravel concrete.

8. Granulated slag sand produced a mortar of inferior tensile strength on short-time tests.

9. Crushed-slag screenings produced a mortar appreciably higher in strength than standard-sand mortar.

Tests thus far made for permeability of slag concrete are insufficient to determine its availability for thin watertight work such as tanks. The weathering qualities of slag concrete are indicated as satisfactory by examination of structures which have been built for a number of years.

SPECIFICATIONS FOR USE OF SLAG FOR CONCRETE

The tests have not been extended over a long enough period to warrant final recommendation for specifications. It appears from the results thus far obtained that for practical construction:

Slag must be air-cooled, crushed, screened from dust, and free from foreign material. The weight of screened slag when shaken to refusal should not be less than 65 lb. per cubic foot.

On account of the nature of the slag, exceptional care must be used in proportioning, mixing, and placing, especially where concrete is chuted, to insure a uniform dense mix.

Commercial practice requires the banking of slags which are low in magnesia (say 1 to 2 per cent) for at least six months. Slags of higher magnesia content (say 5 to 6 per cent) appear to require a much shorter period of seasoning.

If the Joint Committee's method of basing allowable stress on strength of cylinders at 28 days is followed, it would be permissible to use with the slag concrete 50 per cent higher stresses than with gravel concrete, or, conversely, to use lean enough proportions in similar ratio. While so large a stress is not yet warranted without still more extended tests, the results indicate that where slag is accepted for use it is permissible to use at least 15 per cent less cement with the same stresses so as to put the slag concrete on the same basis, commercially, as gravel concrete. This would permit proportions $1:2\frac{1}{2}:4\frac{1}{4}$ in place of $1:2:4$ commonly used in reinforced concrete. The slightly larger ratio of sand to coarse aggregate suggested is advantageous in filling the voids.

FURTHER TESTS NEEDED

Further information is desirable on long-time tests of slag concrete exposed to air and to moisture to compare the relative value of porous

and dense slag as aggregates. Certain of these specimens should be ground so as to expose the aggregate to the weather. Permeability tests, tests of modulus of elasticity, and tests of expansion from changes in temperature and moisture also should be made.

Improvised Auto Snow Plow Clears California Highway

Steel Plates on Front of Chassis Successfully Attack Two-Foot Fall on Los Angeles-Bakersfield Ridge Route

DURING recent storms the ridge route between Los Angeles and Bakersfield, Cal., opened to traffic last year by the California Highway Commission, was subjected to a fall of about 2 ft. of snow. This presented an unusual situation in which special measures were necessary to clear the road so that automobile traffic could get through. This was done with hand shovels, scrapers and any equipment so located that it could be hastily delivered to the blockaded sections.

In connection with this work an enterprising automobile sales agency undertook to demonstrate the use of an automobile hastily equipped for clearing snow from highways. The illustration shows the device used. It consisted of a pair of steel plates fastened to the forward end of the chassis.

Best results were secured, it is stated, by "charging" the snowdrifts with a running start. In this way it was possible to plow through a depth of about 2 ft. of snow and throw it clear of the roadway for a considerable distance before expending the combined momentum and maximum energy of the car. The experiment was conducted by the automobile agents, and the results were not observed officially by state highway officials.



EMERGENCY SNOW PLOW ATTACHED TO AUTOMOBILE

Edison Portland Cement Plant Remodeled

Advantage Taken of 1915 Lull in Business to Install Combination Ball-and-Tube Mills and Other Machinery of Modern Type

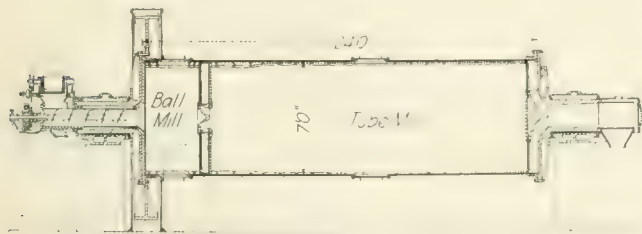
By PERCY H. WILSON
Consulting Engineer, Philadelphia

DURING the year 1915 the Edison Portland Cement Company, owing to the ruinous price at which Portland cement was being sold, shut down its plant at New Village, N. J., and withdrew its brand from the market. The nucleus of its organization was retained, and plans were begun immediately for extensive changes in the mill in order to effect a saving in the cost of manufacture, and at the same time meet those changes in the character of Portland cement demanded by increased knowledge of the material. The plans have been carried out and a comparison of the results obtained by the old and the new methods is afforded.

The original plant started operation in 1902, at a time when only 9,000,000 bbl. of Portland cement was manufactured yearly in the United States, and the principles of the machines installed were such an advance in the art of manufacture as to cause much comment and stamp Thomas A. Edison as one who had thoroughly analyzed the future requirements of the cement-using public. Because of the attention which the original installation commanded, the changes just completed are of more than ordinary interest.

ORIGINAL PLANT A MODEL

A thorough description of the plant as originally built is contained in the Engineering Record of Dec. 26, 1903. Since that time the plant has manufactured and shipped more than 15,000,000 bbl. of cement. The



COMBINATION TUBE-AND-BALL MILLS A FEATURE OF THE REMODELED PLANT

main principles involved, which have been and are being used by practically every cement-manufacturing company in the United States, were the long kiln, the automatic weighing device for proportioning materials, the crushing of material by the use of rolls, the air separation or sizing of the ground particles and the use of individual electric motors for operating all plant units except the rolls.

Cement manufacturers in all parts of the United States, profiting by the experience of the Edison company, adopted such of these principles as best fitted their own particular materials, making changes and improvements in recognition of the development of the art at the time of the change, or in the building of new plants. The adoption of the long kiln and of the automatic weighing device was almost universal. Individual electric drive has been quite generally adopted. Rolls

for preliminary crushing of the raw material have been installed in several plants. The principle of air separation is used in many types of grinding machines accepted as standard, and is in use in many cement plants.

NEW LIMITS IN PORTLAND CEMENT

Engineers and contractors, having become accustomed to the use of natural cement, were not so insistent fifteen years ago on the uniformity of action of Portland cement as they are to-day, and the control of the various stages of manufacture necessary to obtain such uniformity of action was not so generally understood. As greater knowledge was obtained, however, specifications were changed, closer limits were placed on the manufactured product and account was taken not only of the physical properties of the cement but also of its uniformity of action in use. During the last few years it has become quite generally known that not only the amount of cement passing the 200-mesh screen has an effect on its cementing quality, but that cement which would pass a 300, 400 or 500-mesh screen, were such a screen commercially possible, plays even a more important part.

The fineness of the raw material when it enters the kiln also has an effect on the uniformity of the clinker and makes the control of the later processes of manufacture much more simple, insuring a greater uniformity of action of the finished product. It will readily be seen that the method of grinding employed has much to do with the real fineness of both the raw material and the finished product.

EDISON CHANGES RECOGNIZE ADVANCES

The changes which the Edison company has made have fully recognized all these advances in our knowledge of Portland cement. In planning the changes the company has profited by the action of the various classes of grinding machinery in use in other cement mills, not only in the Lehigh valley but in all parts of the United States.

Briefly, for crushing both raw material and clinker down to $\frac{1}{2}$ in. the company has retained its roll crushers. For the final grinding of both raw material and clinker it has installed combination ball-and-tube mills, accepting for the final reduction of its materials the principles of grinding accepted as standard wherever cement is manufactured. The present method of manufacture is in principle the same as that employed by the other Lehigh valley mills.

The objects to be obtained in the remodeling of the plant were the manufacture of a more uniform product, the installation of such machinery as would insure such uniformity with minimum variations and a decreased amount of labor, and with such an installation as would result in a reduction in the cost of manufacture.

It is much more difficult to plan changes in an old plant than to plan a new plant. Dr. H. E. Kiefer, works

manager, made fifteen plans, each of which would accomplish the first two of the desired results. In this work consideration was given to the present power capacity, utilizing to as great an extent as possible the old arrangement of the plant, as well as the old machinery thrown out of commission by the new method of final grinding.

The plan ultimately adopted made necessary a redistribution of power, the moving of the tube mills, which are being used to increase the fineness of coal grinding, and the scrapping of the entire air-separation system, as well as seven sets of rolls previously used for final grinding of both raw material and clinker. A slight rearrangement of conveyor belts was made.

COMBINED TUBE-AND-BALL MILLS

The new installation consists of eight 7x24-ft. combined tube-and-ball mills, made by the Allis-Chalmers Manufacturing Company. These are the largest tube mills in use in the United States. Four of them are for the grinding of the raw material and four for the grinding of the clinker. The installation is the same on both the raw material and clinker grinding sides.

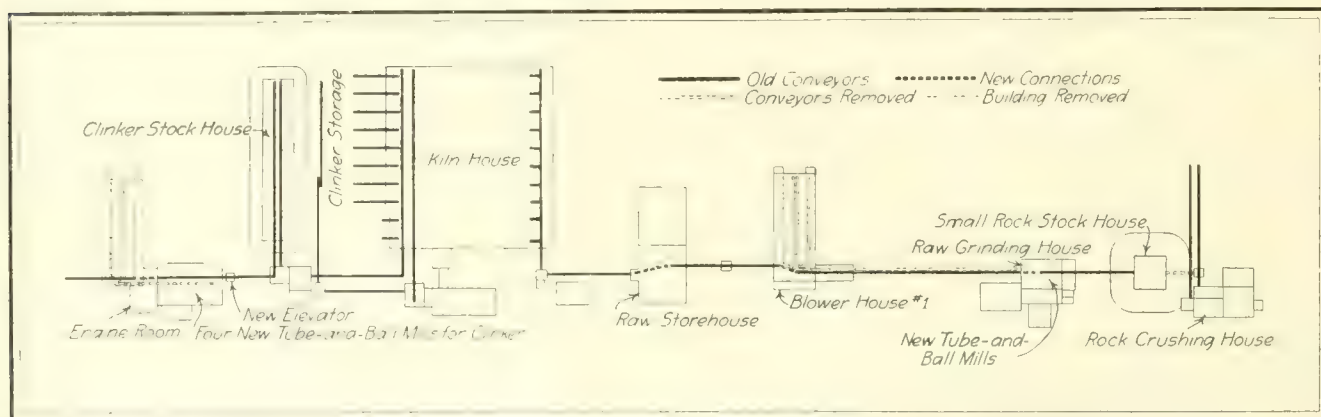
The clinker is ground until 82 per cent will pass a 200-mesh screen, and each tube mill turns out about 75 bbl. per hour.

The following table will give a digest of some of the results obtained, from a mechanical standpoint:

RESULTS OBTAINED BY THE CHANGES		
Power—	Old system	New system
Raw material mills.....	1,712 hp.	1,862 hp.
Clinker mills.....	1,648 hp.	1,688 hp.
Total	3,360 hp.	3,550 hp.
Conveying and Elevating Machinery —		
Raw material mills.....	2,195 lin. ft.	594 lin. ft.
Clinker mills.....	1,942 lin. ft.	318 lin. ft.
Total	4,137 lin. ft.	912 lin. ft.
Number of Motors—		
Raw material mills.....	24	9
Clinker mills.....	36	9
Total	60	18

The two tube mills, 7 ft. in diameter by 10 ft. long, released by the change have been installed in the coal-grinding house, and have increased the fineness of coal grinding to 80 per cent through a 200-mesh screen.

The air-separation system has been eliminated.



GENERAL PLAN OF THAT PART OF EDISON PLANT AFFECTED BY THE RECENT CHANGES

Two of the mills on each side are driven by a vertical cross-compound engine, also made by the Allis-Chalmers company. These two engines were used to run the abandoned roll grinders. The other four mills, two on each side, are driven by individual 450-hp. direct-current motors, manufactured by the General Electric Company.

Each of the tube mills is divided into two compartments. The material entering the first compartment has been previously reduced to $\frac{1}{2}$ in. and under. The grinding in this compartment is accomplished by from 15,000 to 20,000 lb. of steel balls, ranging in size from $2\frac{1}{2}$ to 5 in. in diameter. The length of this compartment can be varied from $3\frac{1}{2}$ to $6\frac{1}{2}$ ft. The material is here ground to such fineness that 90 per cent will pass through a 20-mesh screen. Passing through a slotted plate, the material goes to the second compartment. Here grinding is effected by 70,000 lb. of "man-ganoid" balls, $\frac{7}{8}$ in. in diameter.

The fineness of grinding depends on the length of time the material remains in each compartment, this in turn depending on the speed with which the material is fed into the grinding mill. The raw material is ground until 85 per cent will pass a 200-mesh screen, and each tube mill turns out about 25 tons per hour.

The raw material is being ground so that 85 per cent will pass a 200-mesh screen, instead of 75 per cent, as in the old system. The clinker is being ground to the same degree of fineness as heretofore, but the present method of grinding will increase the very fine material, mentioned before, by about 10 per cent.

The time of set, based on the average of tests of 100,000 bbl., shows: Initial set, old process, 5 hours 45 minutes; new process, 3 hours 13 minutes; final set, old process, 9 hours 20 minutes; new process, 7 hours 6 minutes.

A comparison of strength tests made on material manufactured by the old and the new processes gives:

	Increase in percentage		Increase in percentage
24 hours, neat	2	7 days, 3 sand mortar...	18
7 days, neat	18	28 days, 1 sand mortar...	28
28 days, neat	11		

The cement passes the soundness test without seasoning.

The limits of the variation of the finished product have been greatly reduced.

The color of the new material is steel gray, when gaged neat with water. The color of the material manufactured by the old process was muddy yellow.

Measures Strains in Concrete Building for Period of One Year

Arthur R. Lord Reports Conclusions of Long-Time Test of Flat-Slab Floor—Gets Lower Stresses Than Expected from Past Experience

AS THE RESULT of tests extending over one year, new conclusions relative to stresses in reinforced-concrete buildings have been reached by A. R. Lord, consulting engineer, of Chicago. In a paper presented at the annual meeting of the American Concrete Institute he reports that stresses in the steel during the last four months of the test show practically no change, concrete deformations show progressive increase, the average increase being much more marked in the first five months than in the last seven, and that a shifting of the resisting moment occurs during the first six months, the stresses adjoining the columns decreasing and those at the center increasing, with an increase in the total moment, which averaged 10 per cent for the first eight months, with no increase thereafter. A short abstract of Mr. Lord's paper is presented here, including a diagram showing variation in time of the center deflection and of typical observed unit deformations.

TESTS MADE IN SCHWINN BUILDING

None of the extensometer tests of reinforced-concrete buildings previously made and reported have involved measurements of steel and concrete under a heavy test load held in place through a long period of time. An excellent opportunity was presented by the test of the Schwinn Building, designed by Lieberman & Klein, consulting engineers, of Chicago, shortly before the present Chicago flat-slab ruling went into effect, when each designer was required to show tests to satisfy the building department as to the sufficiency of his design. At Mr. Lord's suggestion, the test load of twice the designed dead and live load was required to remain in place one full year. The ordinary extensometer test was first made in the usual manner, and forty-four gage lines of representative character, and showing the greatest stresses of their kind and location, were selected for the measurements, extending over a period slightly exceeding one year.

The Schwinn Building is six stories in height, approximately 673 ft. long by 80 to 138 ft. wide. The panel tested, selected by J. Norman Jensen of the Chicago Building Department, was an exterior panel about 25 ft. square located on the sixth floor, where the columns were the smallest and the effective span the greatest. The elevators, toilets and washrooms for the building were located in service wings. One of these projected from the panel immediately adjoining the test panel. One concrete duct adjoined the test panel, and openings for two metal ducts were present at each of the wall columns of the test panel.

DETAILS OF TEST PANEL

The slab reinforcement was of the four-way type. One-third of the slab rods in each direct band were carried through at the column and lapped, without being bent up. All the diagonal bars were bent up. The slab was designed to be 9½ in. thick, but actually measured a uniform 10 in. practically throughout the area of the building. The interior drops were 9 ft. square at their

lower surface and 6 in. thick. The wall drops were only 4 in. thick. The exterior walls were of concrete, extending 3 ft. above the floor level and 9 in. thick. The wall columns were 6 ft. 6 in. wide by 1 ft. 6 in. thick, with a pilaster 2 ft. 6 in. wide by 1 ft. thick at the center. They were reinforced by sixteen ¾-in. round rods tied at intervals with ¼-in. wire. The interior columns were reinforced by spiral and longitudinal steel.

The concrete in the test panel, columns and wall was of 1:2:4 mixture. The columns were poured on June 12, 1914, and the test panel on the following day. The wall was poured to the sill level about three hours after

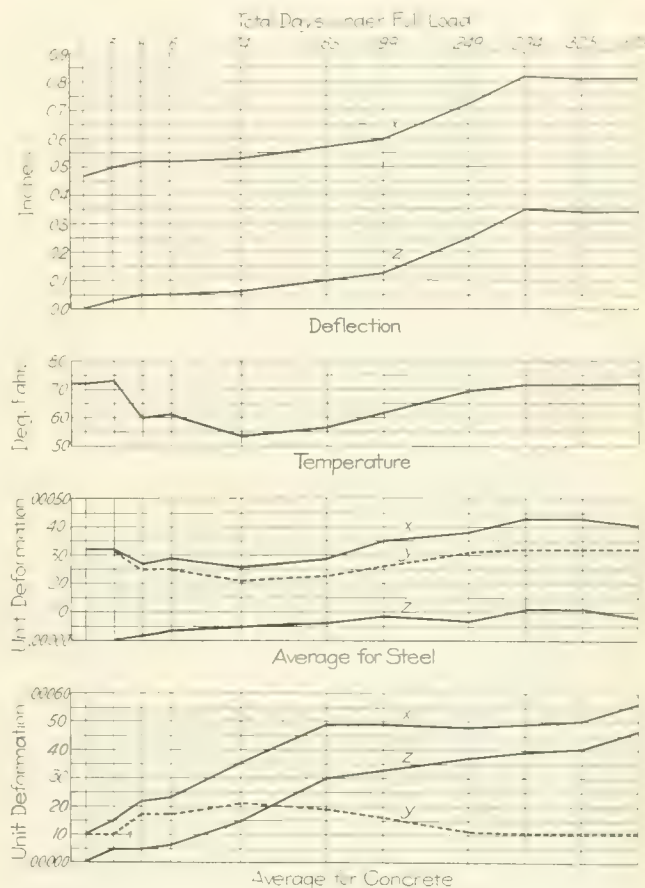


DIAGRAM FOR DEFLECTIONS AND AVERAGE UNIT DEFORMATIONS

the slab was placed; the wall columns were poured to the same height at the same time. The cement floor finish (from 1 to 2 in. thick) was laid on the following day, the total floor thickness being 10 in. The top steel was placed after the rough floor slab concrete had stiffened considerably, and was from 1½ to 1¾ in. below the top of the slab.

TEST LOADING OF SAND

The first load was placed on the test floor on Aug. 14, 1914, using an average depth of 22 in. of bank sand, or about 160 lb. per square foot. On Aug. 15 the load was increased to an average depth of 38 in., very well compacted, giving about 300 lb. per square foot. On Aug. 17 the load was finally increased to an average depth of about 57 in. This final test load may be considered to have been 450 lb. per square foot. It remained in place until Sept. 2, 1915. The floor was designed for a uniformly distributed live load of 150 lb. per square foot.

The deflection at the center panel is plotted on the diagram herewith. No part of the sixth floor for sev-

eral panels around the test load was used during the year, except for light trucking, and it is believed that the effect of loading adjacent panels is not involved in this test. A study of the diagram comparing the temperatures and deflection curves for the year indicates a general tendency for the deflection to increase at all times, and to decrease as the temperature falls and increase as the temperature rises. In the final three months of practically constant temperature the deflection remained nearly constant.

In a slab which is part of a reinforced-concrete building, temperature changes will not take place freely, and in interpreting measured deformations the significant figure is not the actual change in unit deformation but the difference between the actual change and the amount which would have occurred had the slab been free to contract or expand. This difference gives the actual change in stress. In the diagram the unit deformations which would have occurred had the slab been free to contract or expand have been plotted as curves Y, while the actual deformation curves are marked X. The difference between the X curves and the Y curves measures the change in actual stress, neglecting changes in the modulus of elasticity. These values are plotted as the Z curves of the diagram.

GENERAL CONCLUSIONS

The general conclusions can be stated as follows:

1. The stresses in the steel show practically no change during the last four months of the test.
2. The concrete deformations show progressive increase during the year. The average increase was much more marked in the first five months than in the last seven. This increase in the average compressive deformation is in accord with experiments on cylinders under laboratory conditions.
3. There occurred a shifting of a portion of the moment during the first six months of the test, stresses adjoining the columns decreasing, while those at the center increased. This action must be considered in establishing design coefficients.
4. The increase in the total moment, negative and positive, figured from the steel stresses was relatively small and appears to have been considerably less than 10 per cent for the year, with no increase in the last four months.
5. Comparison of the data of this test with that secured by Professors Fuller and More leads to the conclusion that the actual maximum compressive stress at the center of the panel was not in excess of 350 lb. per square inch at the full test load.
6. Both concrete and steel stresses at the end of the year appear to be materially less than those to be expected under the Chicago ruling governing the design of flat slabs.
7. This test, taken together with other time tests of concrete in compression, would indicate that the reported values of the compression in the concrete in previous extensometer tests of flat-slab buildings are somewhat in excess of the true stresses actually present. This applies especially to the final readings when the full load has been in place for 24 hours.
8. Further tests of this nature would seem to promise a material addition to our understanding of the deportment of reinforced-concrete structures under load.

Subsidence Investigations Amply Pay Big Four Railway

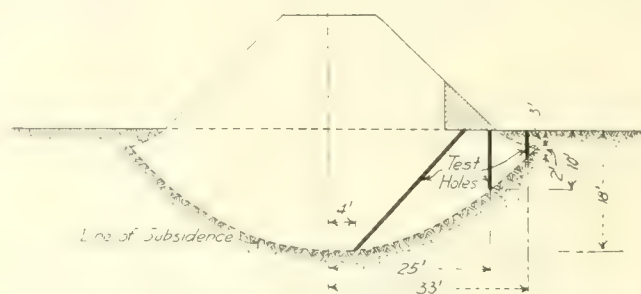
250,000 Yards of Hidden Material Discovered by
Test Pits and Drilling at Total Cost of \$305
—Details of Drilling Outfit

By F. J. WRIGHT

Co-operative Student, University of Cincinnati

IN COMMON with other railroads the Cleveland, Cincinnati, Chicago & St. Louis Railway, in connection with the government valuation work, made subsidence tests of all fills which had given evidence of considerable settlement. The depth to which the different fills had subsided ranged all the way up to 25 ft. The filled material also varied greatly, so that it was found expedient to use two methods in determining the slope of subsidence—(1) the excavation of test pits at the toe of the slope and (2) the drilling of test holes through the fill.

The fills tested by the excavation of pits were either those which had subsided a comparatively small amount



TYPICAL ARRANGEMENT AND DEPTHS OF DRILL HOLES

or those made of rock and other coarse material, making drilling impossible. The pits were dug at the toe of the slope, from 100 to 200 ft. apart, between the points of no subsidence at the ends of the fill. The excavation of each pit was carried back several feet into the fill, the depth varying as the downward slope of the surface of the old ground toward the center of the fill.

DRILL HOLES FOR DEEP FILLS

Test pits were impractical in sounding fills which had subsided more than 8 or 10 ft. The presence of water near the surface of the marsh or bog made the test-pit method more unsatisfactory. When these conditions were found, test holes were drilled down through the fill with an ordinary soil auger until old ground was reached. To facilitate drilling, pits were usually dug at the toe of the slope, in about the manner shown in the drawing.

The drilling outfit consisted of the following material:

One 2-in. soil auger welded to a 6-ft. length of $\frac{1}{8}$ x $1\frac{1}{4}$ -in. galvanized-iron pipe, the upset end threaded for a $1\frac{1}{4}$ -in. standard pipe; ten 5-ft. lengths of $\frac{1}{8}$ x $1\frac{1}{4}$ -in. galvanized pipe, threaded at both ends; three 5-ft. lengths of $\frac{3}{16}$ x $2\frac{1}{2}$ -in. galvanized pipe (casing); eighteen $1\frac{1}{4}$ -in. galvanized pipe sleeve couplings; two 16-in. Stillson pipe wrenches, and one length of 2-in. galvanized pipe fitted with a standard $1\frac{1}{4}$ -in. galvanized pipe tee at the center (handle).

When the test holes were less than 6 ft. deep, the

pipe handle was attached to the end of the auger. In the case of deeper holes the pipe handle was removed and pipe lengths were added as the depth of the hole demanded, the auger being turned with the pipe wrenches. The pipe casing was used only in fills containing cinders, sand, or coarse gravel, and was driven down until it passed through the material causing the difficulty in drilling.

In putting down a test hole, the driller withdrew the auger at about every foot of depth, and the earth brought up was examined and removed. The drilling was continued until material was reached which could be identified with the surrounding land. In cases where the filled earth and old ground were similar as to color and formation, roots and twigs in the latter aided in distinguishing between them.

The estimated yardage due to subsidence of eight fills sounded was 250,000 cu. yd. This work, which involved 1090 lin. ft. of drilling and 270 cu. yd. of shovel work, was accomplished at a total cost of \$305.

Michigan Proposes to Regulate Trucks

Graded Weights and Speeds Allowed, Depending on Tire Widths and Wheel Diameter—Soft Roads Protected

By D. A. THOMAS

Michigan State Highway Department

THERE is now before the Michigan Legislature a tentative law regulating the operation and use of wagons, motor trucks and trailers. It aims, as far as possible, to prevent overloading and consequent damage to the highways in the future. The intent of the proposed law is the reasonable regulation of all trucking traffic, whether horse-drawn or motor-driven, without imposing any great restrictions upon the trucks and trailers already in service. It is designed to be fair and at the same time to safeguard the interests of the public.

Although in Michigan the trucking of heavy loads over country roads is not yet universal, this practice is common in the central and southern parts of the state and in the iron and copper mining districts of the upper peninsula. Shippers, mostly large manufacturers, have found that by using heavy trucks for short hauls overland they could save time and money. While the condition is not, however, as serious as that in many of the eastern states, many roads have been seriously damaged. Michigan proposes to profit by the experience of others and to use the proverbial ounce of prevention.

WAGONS CLASSED AS TRUCKS

The provisions of the proposed legislation will make it unlawful to operate upon the public highways any vehicle the gross weight of which exceeds 15 tons—farm implements and machinery used in road construction excepted. Nor will it be lawful to operate any vehicle—unless motor driven—which has a gross weight per inch width of tire exceeding 600 lb. This latter provision is aimed at wagons. For motor trucks, the greatest loading per inch width of tire is about 730 lb., as indicated in the table. No motor truck or trailer shall have a gage of more than 75 in., measured from center to cen-

ter of tire, and shall not be more than 96 in. wide over all, nor more than 12 ft. 6 in. in height.

Driving wheels having tires of metal that may come in contact with the surface of the road, or which have a partial contact of the metal with the surface of the road, are not permitted. Chains and other non-skid devices are excepted, but the owner of the truck shall be liable for any damage to the road that may result from their use. It is not the intent of the law to prevent the use of steel tires on trailers.

PROVISIONS ARE SPECIFIC

The following limits of sizes, weights and speeds of motor trucks and trailers are established:

SCHEDULE FOR THE REGULATION OF MOTOR TRUCKS AND TRAILERS UPON THE HIGHWAYS

Size of Tire, In.	FOR A WHEEL 32 INCHES IN DIAMETER		Double Tire	
	Max'm Wheel Load, Lb.	Miles Per Hour	Max'm Wheel Load, Lb.	Miles Per Hour
2	700	20	1400	18
2½	900	20	1800	18
3	1200	20	2400	18
3½	1600	20	3200	16
4	1900	18	3800	14
5	2200	16	4400	13
6	2700	14	5400	12
7	3200	12	6400	10

For a 34-in. wheel multiply the above figures by 1.1
 For a 36-in. wheel multiply the above figures by 1.2
 For a 38-in. wheel multiply the above figures by 1.3
 For a 40-in. wheel multiply the above figures by 1.4
 For a 42-in. wheel multiply the above figures by 1.5
 For a 44-in. wheel multiply the above figures by 1.6

All motor trucks or trailers are required to have, conspicuously displayed, information regarding their height of wheel, width of tire, gage, width over all, weight and carrying capacity.

SPRING-TIME CONDITIONS CONSIDERED

Three-quarters of the gross weight of a truck or trailer and its respective carrying capacity shall be on the rear axle, while the front axle is to carry the remaining one-quarter. In both cases the wheel loads must come within the limits prescribed in the table.

An unusual feature of the law provides that during March, April and May, if by reason of the thawing of frost, or rains, the roads are in soft condition, the maximum carrying capacity of tires on all vehicles shall be limited to one-half the carrying capacity of tires as provided in the act. If at any other time any county, district or township commissioner deems it necessary by reason of the soft condition of the roads to put this provision of the act in force, he can do so by the mere posting of notices along the highway.

Special permission for the moving of heavy vehicles which exceed the limits of the law is provided for.

State-Aid Highway Bridges of Standard Design

The road laws of Wisconsin place the bridge work on the state-aid highways under the State Highway Department and authorize the latter to prepare plans and specifications. Previous to the preparation of these standard plans it was customary to have separate plans made by the competing contractors, who naturally were more interested in securing approval than in proper design. Selection was more likely to be based on the merit of the advocate than on the merit of the plan.

Reloaders Used in Place of Expensive Wharf Bunkers

Construction and Operation Features of Panama Canal Coaling Plants Summarized—Emergency Capacity 700,000 Tons

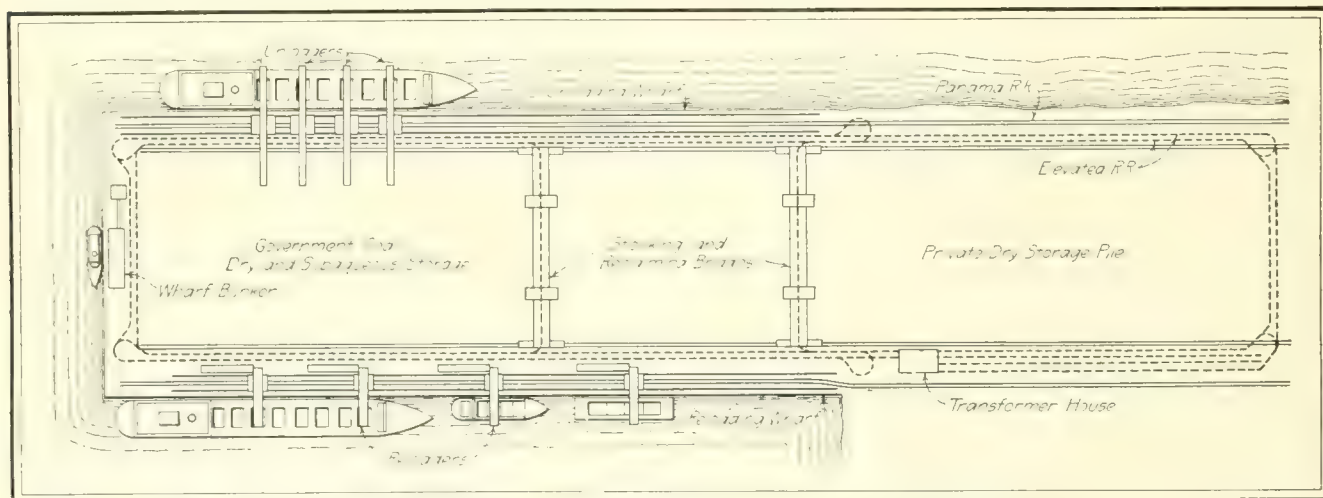
A TOTAL maximum capacity of 1200 tons per hour for the unloaders and 2400 tons per hour for the bridge diggers and reloaders is a feature of the Cristobal coaling plant which has been in commercial operation for several months and is located at the Atlantic terminus of the Panama Canal. The other canal coaling plant, at Balboa, has just been completed. According to an article in the *Panama Canal Record*, on which this description is based, the two coaling plants have a total combined emergency capacity of 700,000 tons, with a combined normal capacity of 500,000 tons, of which 350,000 is at the Cristobal plant, due to the fact that most of the coaling is expected at the Atlantic terminus.

Also supported by the unloading wharf, and commanding its entire length, are four moving units known as unloaders, while four reloaders are found on the opposite side of the pier. On the end wharf is located a wharf bunker of 1500 tons capacity, the use of which is described in the foregoing. The unloaders are operated by steam, although electricity is used for the remainder of the plant, which is electric-lighted throughout.

Surrounding the entire coal pile is a double-track elevated railroad of 3-ft. gage supported by a steel viaduct structure. There are also lines of standard gage running the full length of both the unloading and the reloading wharfs and connecting with the main line of the Panama Railroad.

OPERATION OF COAL-HANDLING MACHINERY

For unloading and stocking, one or more of the unloaders, which are equipped with $2\frac{1}{2}$ -ton buckets and have a normal rated capacity of 250 tons per hour, take



ARRANGEMENT OF CRISTOBAL COALING PLANT, AT ATLANTIC END OF PANAMA CANAL

Another feature in the design is the use of reloaders, in place of the heavy and expensive wharf bunkers which have been provided in most coaling plants elsewhere. However, a wharf bunker has also been built at each of the plants, to be used whenever a small supply of coal is required, such as for tugs or other comparatively small craft, thus rendering it unnecessary to start up the heavy machinery.

GENERAL DESIGN OF CRISTOBAL PLANT

The unloader and reloader wharfs at the Cristobal plant are on opposite sides of a pier along which the bottom is dredged to a depth of 41 ft. at mean sea level for a distance of 1065 ft. With the addition of an end wharf, a total berthing space of nearly 2500 lin. ft. is provided. Beyond the end of the dredged area a length of approximately 600 ft. is considered as shore extension and has no water front.

The coal pile between the two wharfs is spanned by two movable heavy steel structures known as stocking and reclaiming bridges, which are capable of traveling the entire length of the pile and thus, by the addition of other moving units known as bridge diggers, which can move along the bridge, any part of the storage pile may be reached, including the subaqueous as well as the dry

the coal from a collier or a barge and deliver it to 10-ton cars, rated at 200 ft. per minute, running on the elevated railroad. The cars are stopped and started by trackmen and, upon being loaded, travel without attendance over a predetermined route to the dumping point on one of the stocking and reclaiming bridges, whence they continue to the point of reloading. When the wharf bunkers are to be filled, the coal is dumped into a hopper, from which it is fed into the bunker by means of a series of belts.

The coal is reclaimed from storage by using one or more of the four bridge diggers, each equipped with a 5-ton bucket and capable of removing the coal from any point. After delivery to the cars by hoppers and valves, it is carried to the reloaders, to the wharf bunkers or to some other part of the storage pile.

In the case of the reloaders, appendages known as "trailers," consisting essentially of a hopper at the lower end supported on wheels, receive the coal from the cars and deliver it to an inclined belt, from which it is finally transferred to its destination by means of a hinged telescopic chute capable of vertical action. As previously stated, these reloaders are used in place of the heavy and expensive wharf bunkers, the reason being that they are comparatively inexpensive, while

affording a range and capacity of discharge equal to that of a very high wharf bunker.

The weight of coal handled is ascertained by four semi-automatic scales, so situated that a car must pass over a scale before reaching its point of discharge. It is proposed to use a duplicate system of weight tickets on which the scales will print the weight of each car. As before stated, the maximum capacity for the unloaders is 1200 tons per hour, and for the bridge diggers and reloaders, 2400 tons per hour, while the normal values are 1000 and 2000 tons respectively.

BALBOA PLANT

At the Balboa plant the general functions of the unloader and reloader wharves are the same, but the capacities are approximately half those at the Cristobal coaling plant. The wharves make an angle of about 135 deg. with each other, and have a total length of approximately 1600 ft., of which the unloader wharf has 850 ft. and the reloader wharf 750 ft. A depth of 34.4 ft. at extreme low water is provided.

The Balboa cars differ from those used at Cristobal in that they dump on one side only. They receive coal either from unloaders or from berm cranes, and dump directly into the storage pile or into the hoppers of either the wharf bunker or the reloaders, as desired. The berm cranes used for both the stocking and the reclaiming of the coal are of the cantilever type, operated by direct current; they consist of a central tower, resting on wheels, and supporting two cantilever arms that command the full width of the pile. The coal, upon being picked up by grab buckets attached to the berm cranes, may be distributed wherever desired by running the tower along its tracks traversing the central part of the pile and paralleling the unloader wharf. Reclaiming is done by dumping the reclaimed coal into hoppers situated in the towers of the berm cranes, from which it is loaded into conveyor cars on the trestle paralleling the berm crane tracks.

Staves for Wood Pipe Creosoted

The Wenatchee Reclamation District in Washington has ordered material for a 60 and 63-in. wood-stave pipe about 1½ miles long, the staves for which are to be given standard creosote treatment to provide a maximum protection with a minimum of free oil. About 332,000 lin. ft. b.m. of staves will be required. The pipe will convey water across the Wenatchee River and into orchards, where it will be used for irrigation purposes. Heretofore the principal objection to the use of wood pipe in an irrigation district, it is stated, has been the fact that the ends of the staves as well as the sapwood portions start to decay. Machine-banded pipe has proved less satisfactory than might otherwise be the case because the collar decayed very rapidly, as did also the ends of the pipe. The treatment with creosote is calculated to protect those points in the pipe which are most likely to decay, particularly the ends of the staves. The penetration of creosote at these points is much heavier than on the sides of the staves, and it is thus expected that the maximum protection will be afforded where it will be most needed. The creosoted staves are being supplied by the Pacific Creosoting Company of Seattle.

Safety Nets on Structural Work Introduced in California

Where Plank Floors Would Be Costly, Rope Nets Will Be Required—First Trial in San Francisco

By J. J. ROSENTHAL

Safety Engineer, Industrial Accident Commission of California

IN CALIFORNIA there is a state law requiring the use of temporary plank flooring on each floor of a structure to protect workmen below from falling objects. The requirements are that there should be a plank floor for each story as the structural work progresses. But the difficulty of adhering strictly to this ruling in special cases, such as auditoriums, arch trusses in theaters, towers, bridges, etc., is such that it has in many cases been impracticable to comply with the legal requirements.

The Department of Safety of the Industrial Accident Commission of California, after devoting considerable attention to the subject, decided that the use of rope safety nets would afford a measure of protection for workmen who might fall from above; at the same time they can be used in many cases where plank floors would be impracticable. Accordingly the department has now ordered the use of such nets on all structural work where the use of plank floors is not feasible.

The safety nets are made of ½-in. manila rope with ¾-in. border and 4 x 4-in. mesh. The nets come in



NETS IN USE WHERE TEMPORARY FLOORS ARE NOT FEASIBLE

10 x 30-ft. sections, borders being provided with loops at suitable intervals so that they can be readily combined and attached to convenient points on the structural frame.

The nets are patterned after the type which has been used successfully for about a year in Chicago. In this time there have occurred at least two accidents, according to the Illinois records, which would have resulted in fatalities had it not been for the use of the nets. In these instances workmen fell into the nets without injury, instead of dropping about 100 ft. to a concrete floor.

The illustration shows the safety nets in service. These nets, the first of the kind to be used west of Chicago, were made in San Francisco at a cost of \$60 apiece. They are shown in service on the California Theater being built at Fourth and Market Streets, San Francisco, by the Dean Construction Company. The theater is 100 x 170 ft. in plan and is 115 ft. high. The structure is typical of the type in which plank floors would not be practicable and illustrates the class of work on which the Department of Safety hopes to decrease serious accidents by the use of the new safety regulations.

Hetch Hetchy Work Outlined for 1917 to Cost \$11,000,000

This Year to See Construction in Full Swing—
Hetch Hetchy Railroad Soon to Be Operating
—Contractors Invited to Visit Work

M. M. O'SHAUGHNESSY, city engineer of San Francisco, recently issued an annual report relating to the Hetch Hetchy water-supply project. In addition to a detailed account of all the work accomplished on the project in 1916, the report outlines the development program for the present year and recommends that the board of supervisors be instructed to place on sale Hetch Hetchy bonds to the amount of \$11,000,000, in order to provide funds for the work to be undertaken during the present year.

The money requested is to be used for the following construction:

Hetch Hetchy aqueduct.....	\$6,000,000
Hetch Hetchy dam.....	4,000,000
Lower Cherry power development.....	500,000
Contingent construction.....	115,500
Operation and maintenance of Hetch Hetchy railroad.....	110,000
Purchase of railroad equipment (in case operation is not contracted for).....	60,000
Roads, trails and surveys.....	55,000
Clearing Hetch Hetchy reservoir site.....	30,000
Operating sawmill.....	30,000
Inspection and engineering in field.....	30,000
General office work, plans, etc.....	25,000
Water rights and protective work.....	12,000
Compensation insurance for employees.....	10,000
City engineer's revolving fund.....	10,000
Test borings, aqueduct line.....	6,000
Lease of telephone, Groveland to San Francisco.....	4,500
Timber cut on government land.....	2,000
Total.....	\$11,000,000

The railroad from Hetch Hetchy Junction, a station on the Sierra Railway, to the Hetch Hetchy dam site, a total of 68 miles, will be completed within the next few months at a cost of approximately \$2,000,000. This railroad, which has a maximum grade of 4 per cent and a maximum curvature of 30 deg., and involved about 1,000,000 cu. yd. of excavation, has been constructed primarily to haul 233,000 tons of construction equip-

ment and material to the dam and stations along the aqueduct route. Mr. O'Shaughnessy states that besides saving more than \$1,000,000 in the cost of hauling material the road will become a paying investment for the city, since lumber interests in the vicinity of the dam have offered to contract for a large amount of outgoing freight on condition that the road will be made a common carrier.

The power plant to supply electricity for construction purposes is progressing rapidly. The plant will be equipped with Francis turbines operating under a head of 347 ft. The canal line, which has a capacity of 200 sec.-ft., requires five tunnels. This work is under contract and rapid progress is reported. It is expected that the construction power plant will be in operation early in the summer.

PROGRESS ON DAM AND AQUEDUCT

Satisfactory progress on the work at the Hetch Hetchy dam site is reported, notwithstanding the fact that the foundation will be carried to a greater depth than originally planned, on account of the nature of the material disclosed by prospect borings. Contract for the construction of the dam will probably be awarded during the present year. The city's sawmill at Cañon Ranch, 5 miles from Hetch Hetchy Valley, turned out during 1916 1,600,000 ft. b.m. of lumber at a cost of approximately \$10 per thousand.

All the applications required under the terms of the Raker Bill have been filed with the Department of the Interior at Washington, and all but a few on which examination is still pending have been granted. The entire aqueduct line has been surveyed during the last year, and several modifications in the contemplated route have been made. Wherever possible tunnel construction has been substituted for aqueduct pipe in order to provide a line which will be the least subject to earthquake or other contingency. Across the San Joaquin Valley the location was chosen which would cause the least damage to farmlands.

HETCH HETCHY RAILROAD

Mr. O'Shaughnessy suggests that if a satisfactory agreement can be entered into with the Southern Pacific Company, the Santa Fé or the Sierra Railway, it will be advisable to consider awarding a contract to one of these companies for the operation of the Hetch Hetchy Railroad under the direction of the city engineer. However, if no satisfactory arrangement can be agreed upon, the city will organize its own operating department and the road will be run as a municipal utility. In either case the city will retain the active management of the railroad and dictate its policies.

Contractors throughout the country are invited to examine the work as soon as the weather permits (about March 20) and familiarize themselves with all details, so that when bids are invited next June they will be in a position to submit proposals.

An Army Corps for Road Work

Statistics show that about three-fourths of the average prison population is better fitted for outdoor labor than for shop work. This would amount in the United States to about 30,000 or 40,000 convicts who could be utilized for road building.

Tables Aid in Selection of Steel Purlins for Sloping Roofs

Fundamental Formula Derived for Computing Exact Maximum Fiber Stress—Applied to I-Beams, Channels, Z-Bars and Angles

By R. FLEMING

American Bridge Company, New York City

FLEXURE of beams is considered in most textbooks only for the case usually met in practice—that in which the plane of bending moment is perpendicular to a principal axis of the beam. This, however, is a special application of the general case of flexure in which the loading may be in any direction and sections are with or without an axis of symmetry. The subject of oblique loading and unsymmetrical bending has been treated in "Hütte—Des Ingenieurs Taschenbuch," but as far as the writer knows the only American textbooks in which it is mentioned are Heller's "Stresses in Structures," Green's "Structural Mechanics," and the later editions of Johnson, Bryan and Turneure's "Modern Framed Structures" and Burr's "Resistance of Materials." Prof. L. J. Johnson in two papers, "The Determination of Unit Stresses in the General Case of Flexure," in the *Journal of the Association of Engineering Societies* for May, 1902, and "An Analysis of General Flexure in a Straight Bar of Uniform Cross-Section," in the *Transactions of the American Society of Civil Engineers* for June, 1906, leaves little to be desired in his thorough treatment of the subject.

The most common case of oblique loading is that of I-beam and channel purlins on pitched roofs. Fundamental equations will here be developed and tables given for obtaining maximum fiber stress in roof purlins in terms of bending moment for usual sizes of I-beams and channels and also for Z-bars and angles.

FUNDAMENTAL EQUATION

The figure shows an 8-in. 11½-lb. channel on a 6-in. pitch roof. The purlin is supposed to be free to deflect in any direction. Let M represent the bending moment due to the vertical load and α the angle made by the

rafter with the horizontal. Resolving M into components as shown and calling the fiber stresses due to these components f' and f'' we have for the total fiber stress f at any point with co-ordinates x and y the equation

$$f = f' + f'' = \frac{My \cos \alpha}{I_u} + \frac{Mx \sin \alpha}{I_v}$$

$M \cos \alpha$ will produce compression at a and b and tension at c and d, while $M \sin \alpha$ will produce compression at a and c and tension at b and d. The maximum fiber stress will be at a.

Taking the specific case shown in the figure and assuming the bending moment M to be 120,000 in.-lb., we obtain by substituting in the general equation for the point a

$$f = f' + f'' = 0.6756M = 81,072.$$

which is the unit compressive stress at a.

The unit stress at b, noting that α is 0.58 and that the two terms have opposite signs, is 10,092 tension. The unit stress at c, the two terms having opposite signs, is 54,480 compression. The unit stress at d is 36,680 tension.

If the channel were vertical the general equation would reduce to the well-known formula $f = My/I_u$ and the unit stresses at a and b would be 14,860 lb. compression, with the same in tension at c and d.

Table 1 is calculated for purlins at right angles to

TABLE 1—RATIO OF MAXIMUM FIBER STRESS TO BENDING MOMENT FOR VERTICAL LOADING ON I-BEAMS AND CHANNELS

Purlin.	Pitch of roof in inches per foot.									
	0	1	2	3	4	5	6	7	8	
6-in. 12½-lb. I-beam....	0.138	0.212	0.284	0.352	0.415	0.473	0.526	0.573	0.614	
7-in. 15-lb. I-beam.....	0.097	0.153	0.208	0.260	0.308	0.353	0.393	0.430	0.461	
8-in. 18-lb. I-beam.....	0.070	0.114	0.157	0.196	0.234	0.268	0.300	0.328	0.352	
9-in. 21-lb. I-beam.....	0.053	0.085	0.121	0.153	0.183	0.210	0.235	0.257	0.277	
10-in. 25-lb. I-beam.....	0.041	0.069	0.096	0.122	0.146	0.168	0.188	0.206	0.222	
12-in. 31½-lb. I-beam....	0.028	0.050	0.071	0.091	0.110	0.127	0.143	0.157	0.170	
6-in. 8-lb. channel.....	0.231	0.396	0.557	0.709	0.851	0.982	1.101	1.207	1.301	
7-in. 9½-lb. channel....	0.166	0.286	0.422	0.542	0.655	0.758	0.852	0.935	1.010	
8-in. 11½-lb. channel....	0.124	0.228	0.330	0.427	0.517	0.600	0.676	0.743	0.804	
9-in. 13½-lb. channel....	0.095	0.180	0.263	0.342	0.415	0.483	0.545	0.600	0.650	
10-in. 15-lb. channel....	0.075	0.145	0.214	0.279	0.340	0.397	0.448	0.494	0.535	
12-in. 20½-lb. channel....	0.047	0.094	0.141	0.184	0.225	0.263	0.298	0.329	0.357	

the rafter and gives the maximum fiber stress in decimal parts of the bending moment.

The neutral axis N-N can be located by finding the angle θ which it makes with OU. Bearing in mind that the fiber stress is zero for all points on the neutral axis, the term f in the general equation becomes zero and

$$\frac{\sin \alpha}{\cos \alpha} = -\frac{I_v y}{I_u x}$$

But $\frac{y}{x} = \tan \theta$ and $\frac{\sin \alpha}{\cos \alpha} = \tan \alpha$, therefore

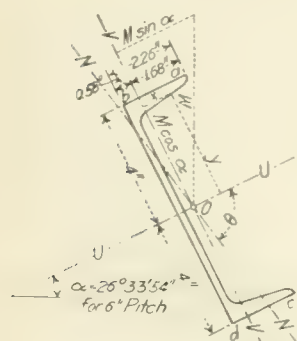
$$\tan \theta = -\tan \alpha \frac{I_v}{I_u}$$

In the case of the 8-in. channel considered, it is equal to —12.143, from which $\theta = 85$ deg. 18 min. The deflection will be in a direction perpendicular to the neutral axis.

It is seen from the table that the maximum fiber stress increases with the slope of the roof. If purlins were proportioned for this fiber stress they would often be much larger than those commonly used. The recently issued Part 3 of Johnson, Bryan and Turneure's "Modern Framed Structures" furnishes an example. In designing purlins for a 6-in. pitch roof with trusses 15 ft. apart and No. 20 corrugated steel covering, the authors require 8-in. 18-lb. I-beams spaced 4.2 ft. apart. In practice 6-in. channels with tie rods are used.

USE OF TIE RODS

It is also seen that the increase in fiber stress is due to the second term of the general equation and that this term must be reduced or eliminated to bring the fiber stress within reasonable limits. This is accomplished partly by the stiffness of the roof covering and partly by the use of tie rods between purlins, both of which



tend to prevent deflection of the purlin in the plane of the roof.

The indeterminate part of the problem is the value to be assigned to the stiffness of the roof covering. In plank or concrete roofs, tie rods are used mainly to keep the purlins in line during erection. A roof covering of sheet metal or loose tiles has little stiffness and the component of the load along the plane of the roof must be taken by tie rods. For a sheet-metal covering a load of 25 lb. per square foot of exposed surface is usually sufficient for the weight of purlins, covering and snow. This acts vertically, and for a 6-in. pitch roof the component along the plane of the roof is $25 \text{ lb.} \times \sin 26^\circ 33' 54'' = 11.88 \text{ lb.}$ The wind pressure, being normal to the roof, does not affect the tie rods.

SIZES OF TIE RODS

The net area of a $\frac{5}{8}$ -in. round tie rod at the root of a thread is 0.202 sq. in., and with tension at 16,000 it is good for a pull of 3232 lb. A $\frac{5}{8}$ -in. tie rod is thus suffi-

TABLE 2.—RATIO OF MAXIMUM FIBER STRESS TO BENDING MOMENT FOR VERTICAL LOADING ON Z-BARS AND ANGLES

Purlin	a	Pitch of roof in inches per foot.							
		1	2	3	4	5	6	7	8
3 x 1/4 Z.....	1.49	1.39	1.27	1.14	1.02	0.89	0.78	0.66	0.55
3 x 5/16 Z.....	1.26	1.12	1.03	0.93	0.83	0.74	0.63	0.54	0.48
4 x 1/4 Z.....	0.87	0.80	0.71	0.63	0.53	0.47	0.39	0.32	0.28
4 x 5/16 Z.....	0.71	0.65	0.58	0.52	0.44	0.39	0.32	0.26	0.22
5 x 5/16 Z.....	0.49	0.44	0.39	0.34	0.28	0.23	0.18	0.20	0.24
5 x 3/8 Z.....	0.41	0.37	0.33	0.28	0.24	0.20	0.15	0.16	0.20
6 x 3/8 Z.....	0.30	0.27	0.23	0.20	0.16	0.12	0.13	0.16	0.19
6 x 7/16 Z.....	0.26	0.24	0.20	0.17	0.14	0.11	0.11	0.13	0.16
2 1/2 x 2 x 1/4 L.....	3.49	3.30	3.11	2.88	2.68	2.46	2.30	2.14	2.01
2 1/2 x 2 x 5/16 L.....	2.91	2.76	2.61	2.41	2.22	2.04	1.90	1.78	1.67
3 x 2 1/2 x 1/4 L.....	2.33	2.22	2.10	1.98	1.85	1.71	1.60	1.49	1.38
3 x 2 1/2 x 5/16 L.....	1.89	1.83	1.73	1.63	1.51	1.41	1.30	1.24	1.15
3 1/2 x 2 1/2 x 1/4 L.....	1.80	1.69	1.60	1.46	1.35	1.22	1.15	1.06	1.12
3 1/2 x 2 1/2 x 5/16 L.....	1.47	1.39	1.31	1.22	1.14	1.02	0.96	0.89	0.93
4 x 3 x 1/4 L.....	1.06	1.00	0.94	0.88	0.81	0.75	0.69	0.65	0.66
4 x 3 x 5/16 L.....	0.92	0.87	0.81	0.75	0.70	0.63	0.59	0.55	0.52
5 x 3 1/2 x 5/16 L.....	0.68	0.65	0.61	0.56	0.51	0.47	0.43	0.41	0.48
5 x 3 1/2 x 3/8 L.....	0.60	0.57	0.53	0.48	0.43	0.40	0.37	0.35	0.41
6 x 4 x 3/8 L.....	0.41	0.38	0.35	0.32	0.29	0.27	0.25	0.27	0.30
6 x 4 x 7/16 L.....	0.35	0.33	0.31	0.28	0.25	0.23	0.22	0.23	0.26

cient for 272 sq. ft. of roof surface on a 6-in. pitch roof. A $\frac{3}{4}$ -in. rod is sufficient for 407 sq. ft. If the roof covering is of "Bonanza" tile or similar material the vertical load will be about 35 lb. per square foot. A $\frac{5}{8}$ -in. tie rod will then be found sufficient for a roof surface of 208 sq. ft. and a $\frac{3}{4}$ -in. rod for 310 sq. ft.

It is important that the ties extend over the ridge of the roof, or where this cannot be done that the uppermost ties run diagonally to the roof truss. Theoretically ties are seldom needed where the slope is less than 3 in. to 1 ft. Roofs of this pitch are generally of plank or concrete and are sufficiently stiff when in place to prevent the purlins from bending in the plane of the roof. It is, however, excellent practice to use ties for erection purposes.

TABLE FOR Z-BARS AND ANGLES

Table 2 gives the maximum fiber stress in decimal parts of the bending moment for Z-bar and angle purlins. As with beams and channels, the purlins are assumed at right angles to the rafter with the top flange projecting toward the ridge of the roof. In all purlins the vertical load is considered to be applied at the center of gravity of the cross-section. Z-bars and angles are seldom used for purlins, and it is difficult to obtain Z-bars except in large quantities.

The calculations and tables of this article have been checked by the writer's colleague, Stanley Smith.

New Tests Indicate Flow of Concrete Under Sustained Load

Earl B. Smith Reports Results for Cylinder and Beams—Flow Continues at Decreasing Rate, Becoming Very Small After a Few Weeks

SUPPLEMENTING the tests reported last year (see the Engineering Record of March 4, 1916, page 329) Earl B. Smith, associate mechanical engineer, U. S. Office of Public Roads, Washington, D. C., reported at the last annual meeting of the American Concrete Institute the results of new tests of concrete cylinders and beams. These tests indicate that gravel concrete has about 20 per cent more flow than limestone concrete. Values of the modulus of elasticity were found to decrease with time, and the flow is shown to continue at a gradually decreasing rate. It is an appreciable amount during three to four weeks, after which the additional change is very small.

The word flow, Mr. Smith states, is not used in the sense of fluidity but in the sense of molecular displacement or rearrangement under the influence of an external force. It is the gradual but persistent deformation which takes place in the material under sustained stress. This flow or continual deformation is not all permanent set but is partly elastic, the recovery being 25 to 50 per cent of the total deformation. The term "time yield" has also been properly used to designate and describe this phenomenon.

Flow should not be confounded with shrinkage. Both factors exist in all concrete and are easily distinguished. Shrinkage exists as a natural consequence, regardless of the size, position or stress, and is influenced mostly by age and moisture. Flow, however, exists by virtue of sustained stress. It is a time-stress effect. Flow and shrinkage are distinguished by means of deformation readings on loaded and unloaded specimens, as has been done in the tests here described. The curves shown are for the net flow values only.

COMPRESSION TESTS ON CYLINDERS

Concrete cylinders of 1:2:4 mix, 3 in. in diameter and 24 in. long, were loaded to 840 lb. per square inch by a dead load applied through an I-beam as a lever. Gravel and limestone were used for the large aggregate, and

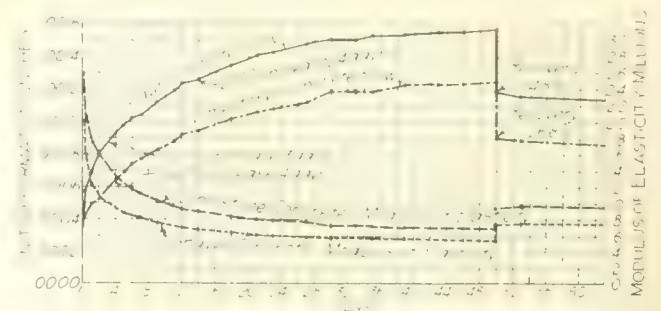


FIG. 1.—FLOW OF CYLINDERS UNDER CONSTANT COMPRESSION STRESS

companion cylinders were prepared for use without loading. In this way the contraction or shrinkage data for correcting the deformation of the loaded cylinders were obtained, thus giving the net flow deformation due to the load. The deformations were measured periodically by a Berry 20-in. strain gage. These cylinders were all cured in the open air, and sprinkled once each day for the first week. The load was then applied after aging 28 days.

The results are given in Fig. 1. The flow is relatively great within the first week. The deformation increases 100 per cent in four or five days, and requires nearly four times as long to increase another 100 per cent. Particularly noticeable is the fact that the flow of gravel concrete is considerably greater than limestone concrete, yet the recovery is approximately the same. This relative flow of concrete as influenced by the character and

the position of the neutral axis should be noticed. This position was computed by means of the extreme compressive deformation values in the concrete and the tensile deformation values in the steel, assuming a straight-line variation.

The law of the flow of concrete is asymptotic. The flow continues at a gradually decreasing rate, and yet is an appreciable amount during three to four weeks. It then occurs more slowly for an indefinite period; but this additional change is very small. The natural total shrinkage of dry concrete is about 0.05 per cent in three months. The total net flow under load, exclusive of the natural shrinkage, may be as great as 0.15 per cent, depending on the time, material and load. The total combined effects of the shrinkage and flow in compression may amount to as much as 0.2 per cent. This would give in a 20-ft. column not reinforced, if loaded to about 800 lb. per square inch, nearly $\frac{1}{2}$ in. deformation, and may produce in a reinforced beam of 20-ft. span fully loaded a sag of nearly 0.3 in. Even the much smaller deformations, which are inevitable, may produce serious results in the setting of apparatus and machinery and in the alignment of shafting, and may easily cause other parts and members of the structure to be overloaded.

MEASUREMENT OF STRESS CONDITIONS

The measurement of stress conditions in concrete structures cannot be made directly by deformation readings unless all the flow constants as to time, material and loading are known. It is readily seen that deformation readings taken only a short time apart will indicate apparently different stress values.

The magnitude of the flow deformations varies quite largely with the kind of aggregate and the mixture. For instance, it is shown in these experiments that gravel concrete has about 20 per cent more deformation than limestone concrete.

The modulus of elasticity of concrete is different for each mixture and for each different aggregate. It changes and decreases in value with time and as the flow deformations increase. If the modulus of elasticity could be ascertained for any particular concrete with due respect to the time factor, stress values could then be determined by simple deformation readings.

In the case of a reinforced beam, the effect of flow in the concrete is to lower the position of the neutral axis, thus enlarging the compressive area, relieving the unit stress in the concrete and throwing more stress into the steel.

Construction Activities in Philippine Islands Increase During 1915

During 1915 approximately 310 miles of first-class road was constructed in the Philippine Islands. This is an increase of 51 per cent over this kind of work completed in 1914. Reinforced-concrete bridges and culverts completed total 371—an increase of 26 per cent over the preceding year, according to the annual report of the Philippine Commission recently issued. One hundred and thirty-nine deep wells have been completed—an increase of 35 per cent over 1914. The increase in reinforced-concrete building work is only 2 per cent; the number of such buildings completed during the year totals 127.

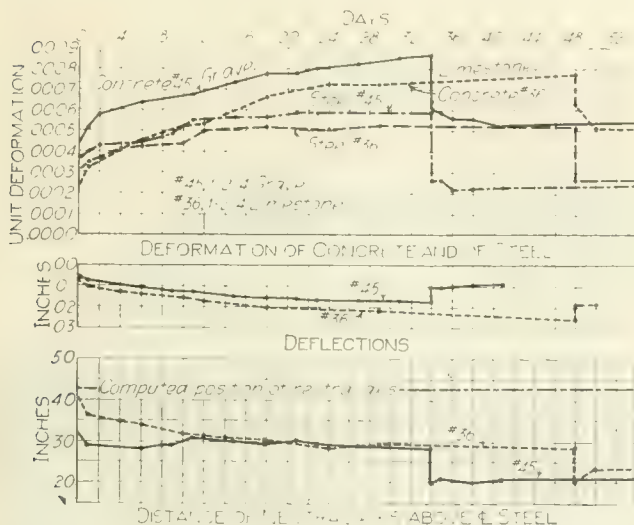


FIG. 2—REINFORCED-CONCRETE BEAM DEFORMATIONS UNDER FIXED LOAD

kind of aggregate should be further investigated. The modulus of elasticity of these two specimens is shown by the two lower curves.

REINFORCED-CONCRETE BEAM TESTS

Two 5 x 8-in. reinforced-concrete beams were cast, and at the age of four weeks were each placed on two supports of 10-ft. clear span and loaded at the center with a concentrated load of 830 lb. The effective depth was 7 in., and the reinforcement amounted to approximately 0.75 per cent, consisting of two plain $\frac{3}{8}$ -in. square bars. The concrete in each case was 1:2:4 mix—gravel for one beam and limestone for the other. Companion sections were cast of each mixture from which to obtain the contraction or shrinkage data.

The results of these tests are shown in Fig. 2. The upper group of four curves shows the net flow in concrete and the increase of stress in the steel. The middle group of two curves shows the deflection of the beams. The lower curves show the change in the position of the neutral axis.

The load was sustained on the gravel beam for 34 days and on the limestone beam for 48 days, and then completely removed. The concrete showed an elastic recovery after two days of 24 per cent for the gravel beam and 29 per cent for the limestone beam. The steel has apparently recovered approximately its original condition before loading. The partial recovery of

Shift Three Truss Spans in Two Moves to Replace Old Girders

Less Than Two Minutes Required for Each Move of Bridge Over Miami River at Dayton—Heavy Double-Track Traffic Preserved

IN RECONSTRUCTING the superstructure of the Dayton Bridge over the Miami River, which is used by all the railroads entering that city, a unique problem was encountered by the contractor. The problem was complicated by the requirement that heavy double-track traffic must be preserved practically without interruption, by the fact that the three new truss spans and new masonry and the old girder spans and masonry did not match up, and by the close proximity to the freight yard and Union Depot, which made it impossible to shift the main tracks laterally and thus allow complete temporary transfer of traffic to the new bridge while removing the girder spans.

After discussing various plans, it was found practicable to erect the three new 223-ft. spans on the down-

stream side of the old bridge, and by using one track of the new bridge and one of the old the downstream girder spans could be removed and the new spans pulled over 16 ft., the tracks being shifted to proper alignment on the approaches, both tracks of the new spans then being used, while the upstream girder spans were picked up by derrick cars and backed out. The final move of the new trusses then brought them into position coinciding with the old position of the tracks. Each move required less than 2 minutes, all three spans being shifted at once.

THREE NEW SPANS 223 FEET LONG

The new riveted steel spans, of the through Pratt type with curved upper chords, are 221 ft. 4 in. long center to center of end pins. They consist of eight panels of 27 ft. 8 in. each, and are 44 ft. deep at the center and 35 ft. at the hip vertical. The trusses, built for double-track Cooper's E-60 live loading, are spaced 31 ft. apart on centers. The distance from base of rail to center of lower chord is about 5 ft., and to mean low water is about 30 ft. The new piers and abutments are square



NEW SPANS ERECTED ON TIMBER BENTS ON DOWNSTREAM SIDE OF OLD GIRDER SPANS

stream side of the old bridge, and by using one track of the new bridge and one of the old the downstream girder spans could be removed and the new spans pulled over 16 ft., the tracks being shifted to proper alignment on the approaches, both tracks of the new spans then being used, while the upstream girder spans were picked up by derrick cars and backed out. The final move of the new trusses then brought them into position coinciding with the old position of the tracks. Each move required less than 2 minutes, all three spans being shifted at once.

The old bridge, consisting of seven deck plate-girder spans 90 ft. long, was built about 1908 and designed to carry Cooper's E-50 loading, using independent single-track girder spans. The flood of March, 1913, washed out old pier 4 entirely and tipped pier 5, and from that time until work on the substructure of the new bridge was begun trains were operated over the replaced girder spans carried by pile bents. When the Conservancy Commission required increased waterway and the removal of obstructing piers (the old girder spans really acting as a dam in times of flood), a new structure was designed of three through curved-chord truss spans of equal length, requiring only two intermediate piers.

instead of skew as in the old bridge. The bridge seats are 7 ft. wide on the abutments, and the tops of the piers are 9 ft. wide.

The masonry for the new spans, as indicated in the plan and elevation herewith, bears little direct relation to the supports of the old spans, in the sense that the replacement operation might be carried out as is usual in cases where new spans are to replace old ones without interruption of traffic—that is, by roller nests on the piers and abutments to allow simultaneous shifting of both the old and the new spans. This difficulty was increased by the still further complication of spans introduced by the shifting of the old girders and use of shorter girder spans carried on pile bents to clear the foundation work.

NEW SPANS ERECTED ON FALSEWORK

The first operation in the reconstruction of the superstructure was the erection of each of the three duplicate steel spans on falsework on the downstream side. Details of the typical intermediate bents and of the pile-bent extensions to the new piers, shown in the drawings, indicate that the intermediate bents were built of two separate units each, and thus could be easily dismantled

stream track of the central span and linked together. About 35 ft. upstream from the center line of the old bridge, and of the new spans in their final position, four deadmen, consisting of two piles each, were driven, and $\frac{3}{4}$ -in. wire rope attached to the upstream ends of the truss spans, passed over sheave blocks at these four points and by right-angled turns at the end floorbeams were carried to drums on the derrick cars. A telltale near the center of the center span indicated the position of each of the moving spans.

The total weight moved was more than 2900 tons, consisting of 2427 tons for the trusses, 300 tons in the floor and 180 tons for the two derrick cars. The advantages in using the derrick cars on the moving trusses are in the central control, the foreman at the telltale easily giving orders to the enginemen, and in the simpler arrangement of sheave blocks, avoiding the application of active external forces.

SECOND MOVE 14 FEET 6 INCHES

After the truss spans had been shifted 16 ft. upstream, the downstream track of these spans was brought into operation by shifting the tracks on the approaches 3 ft. upstream to alignment. The old upstream spans were then abandoned and removed as in the previous case. The piers were now free for the final shift of the new spans, which was accomplished as

shown in one of the drawings. The track rails had been arranged by splicing in such a manner that the outside sections could be removed to allow the pedestals to be placed. Then the inside blocking was cut out and the end of the span slowly jacked down to bearing on the shoes.

The details of the methods used were worked out by S. P. Mitchell, president of the Seaboard Construction Company of Philadelphia, the contractor for the erection. The bridge is owned by the Pennsylvania system and the Baltimore & Ohio jointly, and J. C. Bland, engineer of bridges of the Pennsylvania Lines West of Pittsburgh, had general supervision of its reconstruction. H. S. Goodloe was superintendent of the construction forces.

How Wyoming's Ten-Year-Old License Law Is Working

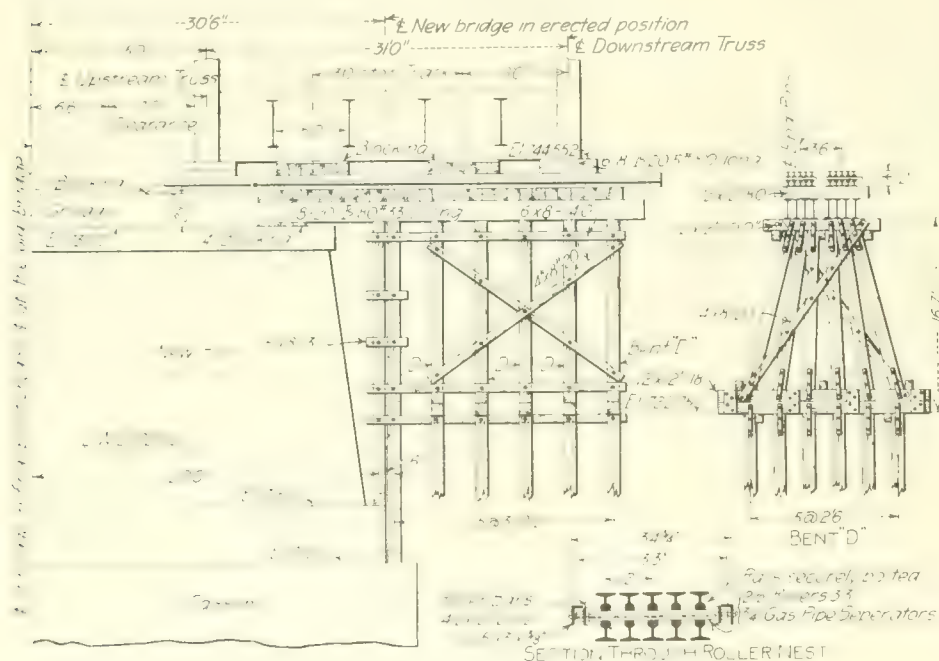
State Engineer Holds That Regulation by Law Is a Success and Increased Standing of the Profession Has Been Obtained

NEARLY 300 licenses for engineers in Wyoming have been issued for one of the five grades provided by the engineers' license law ten years ago, although only 236 are now in good standing. During the two-year period covered by the biennial report of the state engineer, James B. True, who is also secretary of the Board of Examiners, twenty-three licenses have been granted. Three men failed to pass, four applications are pending and three licenses were revoked. Mr. True states that the law is a success and that the standard has been gradually raised by examinations, which are now somewhat more difficult than those originally given.

The first-grade license covers plane surveying only, but the holder is also authorized to lay out irrigation works for the reclamation of not more than 1000 acres, or to design reservoirs when the depth of water to be stored is not greater than 10 ft.

The second-grade licensee may in addition survey rights-of-way, while the third-grade holder may do hydraulic engineering work, such as measurement of the discharge of streams and ditches and the planning of any hydraulic work costing less than \$7,500, or reclaiming less than 1000 acres. The fourth-grade field embraces all other engineering work relative to the utilization or use of water, and the fifth indicates that the engineer is authorized to practice in any lower grade and that he has a knowledge of the irrigation laws of the state as well as of the court decisions interpreting that law.

The distribution according to grades is as follows: One, 72; two, 52; three, 30; four, 60, and five, 22.



FALSEWORK AT PIERS CARRIES RAIL TRACK FOR ROLLING NEW SPAN

before, rolling a distance of 14 ft. 6 in. in less than 2 minutes without a hitch. The approach tracks were then shifted back to the old alignment, the centers of tracks on the new bridge coinciding with the old centers on the girder spans.

After the new spans had been rolled to final position, they were still 2 in. high, and the problem of lowering them to bearing on their pedestals on the new masonry was solved economically without the use of outside falsework. This was accomplished by four 500-ton jacks placed between the position of the pedestal and the inside blocking and working on jacking girders on the extreme edge of the masonry, as indicated in the details

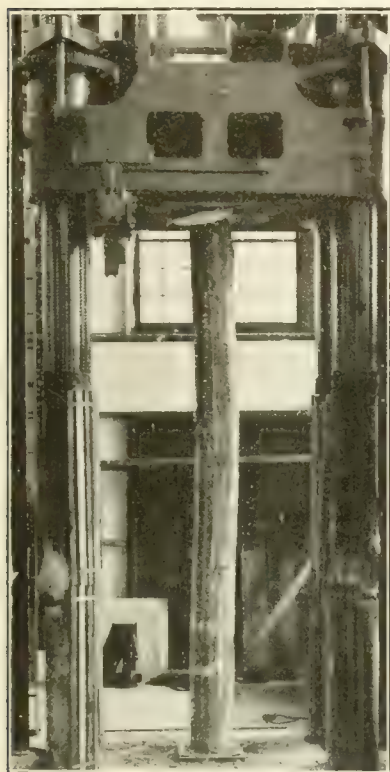
Test Hooped Concrete Columns with Cast-Iron Cores

Emperger Columns Tested at U. S. Bureau of Standards Reported by L. J. Mensch for American Concrete Institute

THAT cast-iron cores of cylindrical or I-section add greatly to the strength of concrete columns hooped with spiral steel reinforcement is shown by the results of tests made in November and December last year at the U. S. Bureau of Standards, under the direction of P. H. Bates, using the 10,000,000-lb. testing machine in Pittsburgh. In a paper written for the American Concrete Institute, L. J. Mensch, of Chicago, who is the American representative for the Emperger column, re-

inforced with longitudinal steel rods fails at a unit compression rarely exceeding 0.0015, and is therefore not suitable to help cast iron with its low modulus of elasticity. Hooped concrete, however, can stand much greater deformations without failure, and the combination of hooped concrete and cast iron makes it possible to develop the ultimate strength of both the hooped concrete and the cast iron.

The diagram here reproduced shows the stress-strain curves for plain and hooped concrete, for various grades of cast iron, and for mild steel. The stress-strain curve for plain concrete ends at a unit deformation of 0.0015 in. per inch of length, at which deformation cast iron is stressed only 15,000 to 25,000 lb. per square inch. The curves for spirally hooped concrete end at much larger unit deformations, and the larger the spiral rein-



TYPICAL FAILURES OF CONCRETE COLUMNS REINFORCED BY CAST-IRON CORE AND STEEL HOOPING

ports the results of these tests and gives tables and diagrams not only for the twenty columns tested in this series but for previous European tests on similar columns. The abstract which follows includes the more important parts of Mr. Mensch's paper and the general results for the 1916 tests.

ORIGIN OF COLUMNS

The invention of hooped cast-iron columns by Dr. F. von Emperger will allow in the future more reasonable sizes of columns in tall and heavy buildings. About eight years ago Dr. Emperger tested steel columns stiffened by concrete. He found that the concrete did stiffen the steel columns, but that the flow of the steel members after the elastic limit was reached destroyed the concrete and placed a limit on the strength at a unit deformation of about 0.001 in. He then conceived the idea that cast iron, with its much greater compressive strength, reinforced with hooped concrete, would make a more suitable column. It is noteworthy that concrete

forcing the larger the unit deformation which the concrete can maintain without failure. At a unit strain of 0.01 cast iron of ordinary quality will develop stresses of from 45,000 to 50,000 lb. per square inch, while high-grade cast iron such as Dr. Emperger used will develop stresses over 80,000 lb. per square inch, provided the column does not fail in bending. The diagram further shows that mild steel cannot develop much more than 37,000 lb. per square inch in the most favorable case in combination with concrete, with or without spiral hooping.

DESCRIPTION OF TEST COLUMNS

To verify these theoretical deductions, Mr. Mensch, in September and October of last year, made twenty columns about 12 in. diameter and from 6 to 14 ft. long. Concrete was a 1:1:2 mix, and the dimensions and reinforcement are given on the diagram accompanying the table of results reproduced herewith. With each batch one 6 x 12-in. concrete cylinder was made,

and tested at the age of 62 to 66 days, when the columns were tested. Universal Portland cement, good clean washed torpedo sand, and gravel passing a 1-in. ring and with particles varying from $\frac{3}{8}$ in. up were used. The spiral steel, furnished by the American System of Reinforcing, was high-carbon wire, fastened on opposite sides to $\frac{1}{4}$ -in. round vertical rods. The vertical square deformed bars were also of high-carbon steel, wired to the spiral at about 1-ft. intervals.

CAST-IRON CORES

The column cores were made by the American Building Foundry Company, of Chicago, of a mixture of 50 per cent gray iron and 50 per cent scrap. Test cubes of 1-in. sides showed a stress of 100,000 to 150,000 lb. per square inch, but the actual castings as typified by a 5-in. column 24 in. long showed only an ultimate strength of 72,700 lb. per square inch and an initial modulus of elasticity of 10,000,000.

The cast-iron columns varied only about $\frac{1}{8}$ to $\frac{3}{16}$ in. in thickness where the core was supported by chaplets, and between this point varied as much as $\frac{1}{2}$ in. in thickness. The column ends were machined in the foundry. The sections were often 10 per cent weaker than the theoretical section.

In order to make extensometer readings for vertical deformations, holes were cut in each column adjoining vertical rods at diagonally opposite sides and at the quarter points along the columns. In these holes $\frac{3}{8}$ -in. round iron plugs were fastened. Punch marks were made in these plugs, also in the adjoining $\frac{3}{8}$ -in. square bars, from which the extensometer readings were taken

by means of a 6-in. Berry gage. Besides the extensometer readings at the twelve points 6 in. center to center, three vertical extensometer readings, called A, B and C, were taken on each column for distances within 1 or 2 ft. of the length of the column. The apparatus for these latter measurements consisted of two iron rings fastened by screws to the columns at about the correct distance. The upper ring carried three brass tubes about $\frac{3}{4}$ in. in diameter which rested, by means of needles, on the gage fastened to the lower ring.

While the extensometer readings on the 6-in. gage length are often erratic, due to local conditions, the readings at the points A, B and C were comparatively very uniform. The extensometer readings were taken after the pump was stopped, and owing to the plasticity of the column the load slightly dropped off during the five minutes it took to make fifteen readings. From the few tests to determine the drop, it is believed that it did not amount to more than 1 per cent.

RESULTS FOR COLUMNS WITHOUT CAST-IRON CORES

For the hooped concrete columns without cast-iron reinforcement the first crack occurred at an average load of 465,000 lb., or 4110 lb. per square inch, while the concrete cylinders failed at an average of 3630 lb. per square inch. After the first crack the columns compressed faster and the maximum load was evidently reached when the spiral reinforcing was near its ultimate strength. The average maximum load was 540,350 lb., or 4778 lb. per square inch, which agrees very well with the formula proposed by the National Concrete Institute.

In order to find out how much the cast iron carried in the other columns, the assumption was made that 4778 lb. per square inch was the strength of the concrete within the core and that the remaining load was supported by the cast-iron column.

RESULTS FOR COLUMNS WITH CAST-IRON CORES

The ten columns with cast iron reinforcement, 8 to 12 ft. long, showed very uniform results, as indicated by the table. Only in column 3 appeared the first crack at

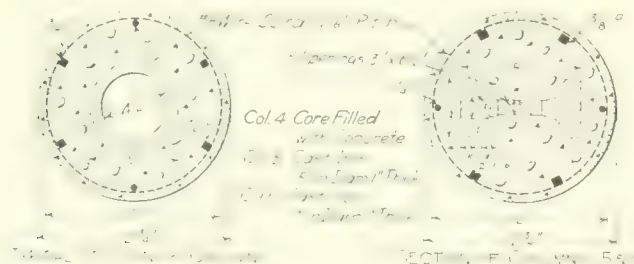
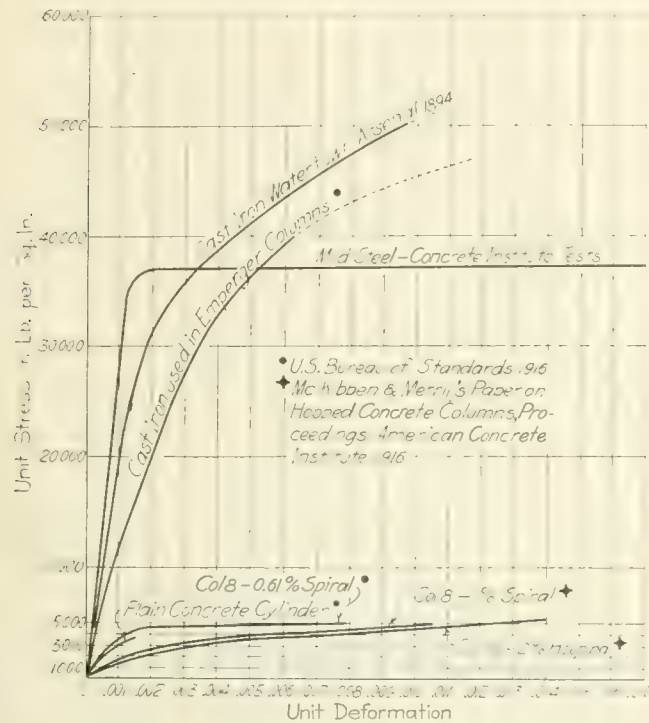


Table of Results—Tests of Emperger Columns, United States Bureau of Standards, 1916

Col. No.	Length, feet	Actual area of concrete within core, sq. in.	Area of vert. steel, sq. in.	Area of cast iron, core, sq. in.	Ratio cast iron to concrete, per cent	TOTAL LOAD IN POUNDS			Average unit load on cast iron, pounds per sq. in.	VERTICAL UNIT STRAIN		Ultimate strength 6x12-in. concrete cylinders, lb. per sq. in.
						At first crack	Maximum	Average carried by concrete	Average carried by cast iron	At $\frac{1}{4}$ max. load	At max. load	
1	6	81.8	0.66	12.37	14.6	436,500	1,057,000	1,011,100	51,500	0.00042	0.0083	4300
2	6	81.8	0.66	12.37	14.6	776,000	1,026,000	405,000	636,500	0.00040	0.0090	4300
3	8	84.8	0.66	12.37	14.6	436,500	940,000	405,000	535,000	0.00034	0.0115	3750
4	8	100.7	0.66	12.37	14.6	570,000	1,031,500	481,150	550,350	0.00052	0.0080	3750
5	8	93.5	0.66	12.57	13.4	679,000	925,000	446,600	478,400	0.00035	0.0074	4150
6	8	74.6	0.66	12.52	16.8	565,500	920,000	356,300	563,700	0.00037		4150
7	10	100.1	0.66			440,000	518,500	540,350		0.00025		3800
8	10	100.1	0.66			440,000	562,200			0.00022		3370
9	10			12.37			180,000	510,000	41,200			
10	10			12.37			540,000					
11	10	81.8	0.66	12.37	14.6	643,500	911,000	941,375		0.00035		3750
12	10	84.8	0.66	12.37	14.6	650,000	940,000			0.00035		3750
13	10	84.8	1.22	12.37	14.6	776,000	800,000	405,000	536,375	0.00041		
14	10	84.8		12.37	14.6	727,500	1,066,500			0.00045		
15	12		1.22	13.40	13.4	850,000	1,071,800	1,009,900		0.00036		
16	10		1.22	13.40	13.4	570,000	996,000	476,360	533,540	0.00036		4250
17	12	84.8	0.66	12.37	14.6	732,500	951,500	930,250		0.00037	0.0070	
18	12	84.8	0.66	12.37	14.6	630,500	909,000	405,000	525,250	0.00041	0.0060	
19	14	84.8	0.66	12.37	14.6	630,500	888,500	858,000		0.00038	0.0100	
20	14	84.8	0.66	12.37	14.6	679,000	827,500	405,000	453,000	0.00033	0.0061	4400

the low load of 436,000 lb. or about one-half the maximum load; in all other cases the first crack was noticed at loads of 600,000 to 800,000 lb., or at 0.6 to 0.8 of the maximum load. The unit deformation at this time varied from 0.00125 to 0.00175—practically the same as for plain concrete cylinders at failure.

At a load of about 800,000 lb. considerable spalling of the outer shell occurred. Sometimes the spalling started at the top or bottom, or it might start in the center, clearly indicating that the cast-iron column carried the stresses over the weak spots in the concrete. Near the ultimate load sometimes one or two spirals burst, but still the cast-iron column helped to distribute the load, and spirals often burst in quite distant places.



STRESS-STRAIN DIAGRAM—CAST IRON, STEEL AND CONCRETE

When the pump was working after the maximum load was reached, the concrete where the spiral burst was destroyed and after a few minutes fell out and exposed the cast iron. Even then the cast iron probably carried 80 per cent of the maximum load. In two cases where the pump was not kept running perhaps ten minutes after the maximum load was reached and the cast iron was exposed for about 6 in., circular cracks appeared around the columns about 12 in. on centers, which showed the tendency of the cast iron to transmit the load by bond again into the undamaged part of the concrete.

In column 4 the cast-iron core was filled with concrete and showed a gain proportionate to the extra concrete.

The cast-iron cores for columns 13 and 14 were spliced 3 ft. from one end. The average load carried by these two columns was 981,000 lb., while columns 11 and 12 averaged only 925,500 lb. Columns 13 and 14 had 0.6 sq. in. of extra vertical steel, which would account for not more than 24,000 lb.; so that it may safely be stated that splices do not diminish the strength of such columns.

Columns 15 and 16 had I-sections of reinforcement, as shown in the drawing. The object was to find

whether a smaller radius of gyration in one direction can be counteracted by the stiffness of the concrete. These columns carried practically the same unit stresses as columns 11 and 12 with round cast-iron cores. Such sections may be of advantage in cases where continuous concrete girders are attached to the columns, giving the girder bars an opportunity to pass by. Or, in high buildings, they may be used for outside columns where great stiffness is required in one direction.

CONCLUSIONS AND OTHER TESTS

From the fact that the maximum loads of all columns were the same when the spiral reinforcement was near the breaking point, we may infer that higher ultimate values for the strength of these columns would have been obtained if a larger percentage of spiral reinforcement had been used. This conclusion is justified also by tests made by Dr. Emperger since 1911.

Tests made by the Austrian Concrete Institute, using 1:2:4 concrete, reported in Volume 3 of the *Proceedings*, 1911, included two columns with a core diameter of 9.6 in., a length of 10 ft. and spiral reinforcement slightly exceeding 3 per cent. They failed at an average concrete unit stress of 7500 lb. per square inch and an average unit stress in the cast iron of about 60,000 lb. This cast iron was of ordinary grade. In all other tests Dr. Emperger used high-grade cast iron with an ultimate strength of 110,000 to 120,000 lb. per square inch. Combined with high percentage of hooping, this cast-iron reinforcement resulted in uniform strengths such as could be obtained only with a solid-steel section. For example, one column had a concrete area inside the core of 9.86 sq. in., a cast-iron area of 3.12 sq. in., or a total of 12.98 sq. in., and failed at a total load of 392,000 lb., equivalent to about 30,000 lb. per square inch of the area in compression. This should be compared with the 8000 to 10,000 lb. per square inch of area of an inclosed rectangle for structural-steel columns made up of angles and plates.

Seven tests were made for the city of Dresden in 1916, using four angle-shaped cast-iron sections with tie plates, ties and hooping, limited to 0.69 per cent, as they represented to small scale the arch ribs for a span of 460 ft. Although tests of plain concrete cubes averaged less than 2000 lb. unit stress, the columns failed at an average stress of 12,000 lb. per square inch of core area.

Mr. Mensch finally concludes that in the hooped concrete column reinforced with cast iron there is obtained a compression member which can sustain stresses up to 17,000 lb. per square inch, hence allowing smaller sizes than columns built of structural steel at a very great saving in cost.

Cubic Cost of Washington Buildings

The cost of district and school buildings for the District of Columbia, which have ranged between 14 and 17 cents per cubic foot, will probably cost from 18 to 20 cents within the next year, according to the 1916 report of the Engineer Department. Last year three school buildings cost approximately 14½ cents, while an engine and truck house averaged 19 cents. It is further stated that the buildings and repairs cost less in Washington than in any other city with the exception of Cleveland.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

State Highway Department for Wyoming

SIR: In your issue of Feb. 10, page 235, I notice a statement that Wyoming is prohibited by its constitution from participating in works of internal improvement. This was true until recently, but our constitution has been amended to eliminate this clause.

It might be of interest to add that the legislature has just passed an act creating a state highway department and providing funds for the construction of state highways. The bill which passed was drawn and indorsed by the Wyoming Good Roads Association, of which G. E. Parisoe of Laramie is president.

This act creates a state highway commission of five appointed by the Governor. The commission is to select a state highway engineer, who is to be the executive head of the department and have complete supervision over the construction and maintenance of highways and bridges.

Z. E. SEVISON,

Laramie, Wyo.

Civil and Irrigation Engineer.

Quartz Gravel or Defective Design?

SIR: Referring to the report of Ira H. Woolson on the effect of fire on the reinforced-concrete warehouse at Far Rockaway, N. Y., abstracted in the Engineering Record of Jan. 20, page 98, in which he places the blame of the failure on the use of quartz gravel, I would like to call attention to a still more serious and sinister feature of this structure, and one that can be controlled by the builder or engineer with greater facility than the selection of stone not affected by heat.

This building is another exemplification of failure due to bad standards of design, another of a long and growing list of failures that cry out against the use of the rodded column. The column shown on page 98 failed because it was a rodded column. This is something that can be positively demonstrated. If this column had been reinforced with closely spaced circular hooping and upright rods, it could not possibly have failed as it did under the load it sustained. The proof of this is found in the record of numerous tests on hooped columns that could be cited. Many of these have stood test loads of several thousand pounds per square inch even after bowing out of line several inches. It is impossible that the concrete within the hooping could be in any other state than one of disintegration—worse than that of the concrete in the heart of the column in the Far Rockaway warehouse. A properly designed hooped column could therefore not have failed, for it would not be subject to several thousand pounds per square inch of load. Hooping, furthermore, would retard or prevent cracking of the core. Every large rodded-column structure is subject to menace in case of fire, or possibly in the absence of fire.

Another feature of bad standards of design is shown in the failure of the floor girders. This is the absence

of bent-up and anchored shear or diagonal tension reinforcement in the part of the fourth floor that failed. There were "shear members," so called, but bent-up and anchored steel was lacking; hence the failure. Every structure lacking bent-up and anchored steel in the beams is subject to this second menace in the case of fire, or possibly in the absence of fire.

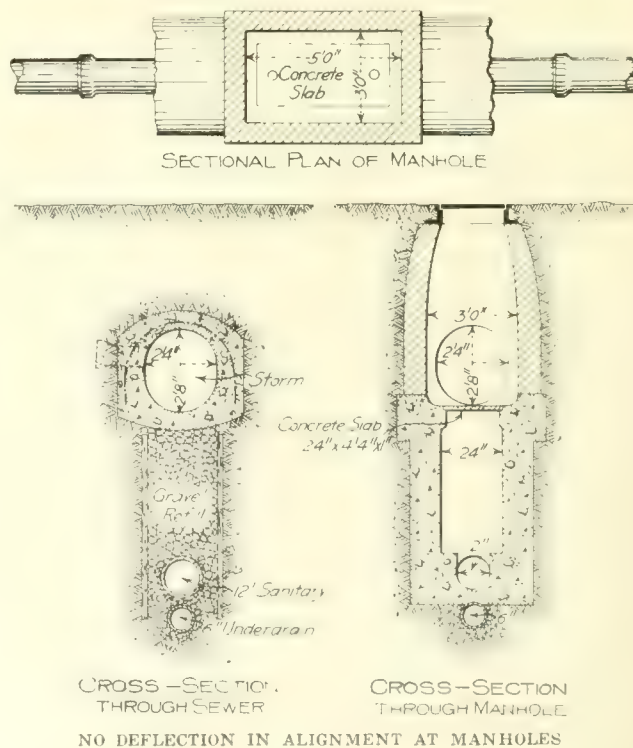
Pittsburgh.

EDWARD GODFREY.

Two Sewers Laid in One Trench

SIR: I was interested in reading the article in your issue of Jan. 27, page 138, about the two sewers laid in one trench. We have been constructing two sewers in one trench in Cambridge since 1889, ranging in a great variety of shapes and sizes from a storm sewer 5 ft. 8 in. by 6 ft. over an 8-in. sanitary sewer to a 24-in. storm sewer over a 24 x 26-in. sanitary sewer.

The method of constructing the manhole is quite different from that described. No deflection in the alignment of the upper sewer is made, as the manhole is built to keep the flow separate and yet to give access to



both sewers by constructing a removable bottom or floor slab in the upper chamber. In order to inspect and clean the lower sewer, it is necessary only to tilt up the floor slab by means of the two-ring bolts. This would usually be done when nothing was running in the storm sewer.

The drawing shows a rather interesting example of this type of construction on account of the unusual dis-

tance between the two sewers. Ordinarily, they are only about 2 ft. or less apart, thus reducing the depth of the lower chamber and increasing the accessibility of the lower sewer.

This style of "two-story" manholes has given excellent satisfaction, being convenient as well as inexpensive.

Cambridge, Mass.

L. M. HASTINGS,
City Engineer.

SIR: I note in your issue of Jan. 27, page 138, Manley Osgood's design for two sewers laid in one trench. This is an expedient adopted by the writer in the plans for the sewerage system of New Hartford, N. Y., in 1896, the only essential difference being that the storm-water sewer was placed below the grade of the sanitary sewer, and with porous joints, to lower the ground water, thus enabling easier construction of the sanitary sewer and greater security against leakage, for the joints were made with jute and cement. For good foundation the sanitary sewer was laid on a shelf or shoulder cut in the side of the trench made for the lower sewer after that was laid and covered. The invert of the sanitary sewer was at the same elevation as the top of the other. Both have been continuously in operation and without trouble of any kind.

A. M. SCRIPTURE,
New Hartford, N. Y. Consulting Engineer.

What Are They Doing About It?

SIR: In your issue of Jan. 20, page 115, under the caption, "What Are They Doing About It?" is a letter from Prof. F. H. Newell on the subject of Professor Baker's report on the pavements of Chicago (see Engineering Record of Dec. 30, 1916, page 790).

In answer to Professor Newell I will say that the Western Society of Engineers and the Illinois Society of Engineers will be asked to investigate the statements and conclusions contained in Professor Baker's report, with a view to determining the accuracy of the report, especially those statements and conclusions that have led the people of Chicago to believe that the property owners have been robbed of \$400,000 annually by the paving contractors of Chicago.

Unless these societies and others have sufficient interest in the honor of the societies and the honor of their members to make such investigations and to expel from membership any engineer who is guilty of permitting such wholesale robbery as is alleged, or expel from membership any engineer who would make such wholesale accusations against engineers, when such accusations are unfounded, then I fail to see of what benefit such societies can be to engineers who are self-respecting.

Before the issuance of this report I would have agreed with Professor Newell that no question can be raised as to Professor Baker's ability and fairness. Since reading this report I am convinced that the conclusions in it relating to this robbery of property owners is entirely unfounded by the statements in the report and that at least some of the statements, upon which these conclusions are based, are quite incorrect, and in at least one instance Professor Baker had definite data which contradicted his statement in the report. I refer specifically to his statement on page 12, where he says:

"The shortage in each of the three cases, respectively, is: 21 per cent, 12 per cent and 21 per cent, or an average of 18 per cent, regardless of the relative areas or of the relative number of observations. The above are all the definite data I have or can find on the thickness of the concrete base. If it be assumed that these data are representative, the possible loss to the property holders by skimping may be computed as follows: In 1915 the board laid 1,498,000 sq. yd. of pavements having a concrete base. The materials of the base cost about 60 cents per sq. yd. Hence the loss was $0.18 \times 1,498,000 \times 60 \text{ cents} = \$161,784$."

The investigators of the finance committee furnished to Professor Baker more than 100 reports covering various features of the work. Among these were a number relating to the thickness of concrete. Twenty-nine of these reports show that work of laying concrete foundation was in progress at the time of inspection of the investigator, besides five other cases where the thickness of the concrete was indicated on the reports. Nineteen of the reports make no mention of thickness of concrete; four of them show the thickness to be 6 in.; four of them are marked "O. K."; four of them show the thickness to be between 5 and 6 in.; three of them contain the "definite data" referred to by Professor Baker.

Professor Baker then assumes that all of the work done by the Board of Local Improvements is of the same character as that disclosed in the three cases, which are the worst disclosed by all of these reports.

In the portions of the report relating to asphalt pavements there are similar misstatements and unfair conclusions.

C. D. HILL,

Engineer, Board of Local Improvements.

Chicago.

[Professor Newell's comment on Mr. Hill's letter follows.]

SIR: I have read C. D. Hill's letter and regret to see that he is so deeply stirred and that he unduly emphasizes the question of "honor." In my opinion we should carefully distinguish between efficiency and honor in such matters. The efficiency of an organization may be controlled by conditions entirely outside of the honor or integrity of the men in responsible charge. Often they are so involved in other matters that they cannot get out into the field or reach down into their organizations and really know what is taking place. Under such conditions they should welcome any suggestion which, though unpalatable, may, in the end, lead to improved conditions.

I may have as a friend and neighbor a man of the highest personal integrity, and yet I may not find that in business dealings he is "delivering the goods." There are an infinite number of reasons why this may be the case, none of which reflects upon his honor but is the outgrowth of the environment.

In the present case an inspection was made in good faith, the results reported and the statement clearly made that if it is assumed that these data are representative, then certain possible losses have occurred. This should not be considered as a question of honor, but should be calmly and seriously considered with a view to endeavoring to rectify conditions if they are as indicated by the observations made.

Because of the strong personal attitude taken in the matter, it seems to me that it is unwise to continue along the present lines, but rather try to ascertain the physical facts.

F. H. NEWELL,
Professor of Civil Engineering, University of Illinois.
Urbana, Ill.

Patented Pavements and Standard Specifications

SIR: I beg to thank you for publication in your issue of Jan. 20, page 114, of my communication sent you recently, together with your editorial footnote comments thereon. I am not sending you this acknowledgment with either request or intention that you publish it, but you may feel free to do so if you so desire.

It is true that the illustrations accompanying my paper on "The Passing and Conservation of Macadam City Streets and Country Roads" did contain photographs of Bitulithic and Warrenite, and were so labeled. It is also true that a "cut-in" on the film of the Columbia River Highway did refer to this construction as Warrenite road. It is also incidentally true that that "cut-in" was exactly as we had received the film from the Shriners, who had taken it for specific use at the Shriners' Buffalo Conclave and loaned it to us for specific use at the Newark convention of the American Society of Municipal Improvements. I do not think that this use of the name of the kind of construction used can at all be attributed to commercialism. If, for instance, the road had happened to be concrete, brick or asphalt, you surely would not have considered the subject properly presented if they had simply said "a road," or "a street" or "a pavement," and would not have considered the fact that someone is interested in selling brick, Portland cement or asphalt as any reason for not giving the road or pavement construction its proper commercial name.

Apply the same rule to your business. You certainly get a certain amount of commercial advantage every time that the Engineering Record is referred to in technical association meetings or otherwise, and you would not consider that a reference to some such designation as "an engineering paper with a red cover" would be suitable or proper, or give the persons addressed a correct idea of what it meant.

In other words, Mr. Editor, your trouble is that you apparently feel that a patent, however valuable, is a thing which should be ignored in public mention, and you seem to regard the word "standard" as not including anything that is patented, whereas it seems to me very clear that extent and success of use are the things which determine standardization. If patented constructions of merit are to be ignored by engineering societies or engineering periodicals, then it means that those societies, periodicals, and the public, to the extent the public is influenced by them, are seventeen years behind the times, for it is fair to assume that everything novel and destined to be at all generally useful will be patented. Surely if an article is meritorious its use should not be ignored or discouraged simply because the article is patented, especially in view of the fact that the United States Constitution, patent laws and decisions of the United States Supreme Court take a directly opposite view.

The following extracts from Walker on "Patents" is illustrative of the point:

"In the United States of America, the superior right of an inventor to his invention has a far better foundation than could be furnished by the prerogative of any kind. That foundation is the consent of the people of the United States: a consent primarily expressed in the federal Constitution, and elaborately defined in the federal statutes."

"The right of property which an inventor has in his invention is excelled, in point of dignity, by no other property right whatever. It is equaled, in point of dignity, by the rights which authors have in their copyrighted books. The inventor is not the pampered favorite or beneficiary of the government or of the nation. The benefits which he confers are greater than those which he receives. . . . He receives nothing but a contract, which provides that, for a limited time, he may exclusively enjoy his own."

Many extracts of similar force, directly from Supreme Court decisions, could be easily given, but it seems to be quite unnecessary, as the propriety of patents as an economic policy is an established part of practically every progressive government in the world.

I quite agree with you that it is incompatible with the dignity and principles of a technical society to show "commercial partisanship," but I beg to reiterate that proper mention of a patented construction by technical publications, or the inclusion of standard patented constructions among the standard specifications of a technical society, is not in any sense "commercial partisanship."

On the contrary, I believe that to refrain from including the standard as such because it is patented would be a serious omission from what the public has a right to expect from such periodicals and societies.

You say: "If Bitulithic can have a specification, why not every other patented paving that has proved its worth?" My answer is, there is no reason why any patented paving or any other patented article in municipal construction should not be referred to and standardized by a standard association, provided it has "proved its worth."

In my previous communication I said: "In fact, I think 'standard' specifications should include every form of construction which has had a long or broad enough practical use to prove its 'efficiency and economy,' whether the desideratum be from either the points of view of high grade and correspondingly higher cost, or of lower cost and, although inferior, economically useful at the price." My point is that no article is either more or less standard because it is or is not patented.

As to the American Society of Municipal Improvements, I hope that I will always be found, as I believe I have been during the past 20 years, in the position of broadly and not narrowly doing what I can to assist the society along proper lines. The society in convention has consistently refused to do the things which you condemn, and your criticisms do not apply to the body as a whole. I believe that whatever criticism is justly due should be placed at the door of not exceeding half a dozen of its active members, who because of either lack of attention or lack of time, if not intention to mislead the society, have withheld their reports until the last hour, instead of making them a sufficient time

before convention so that they can be presented to all the members for their consideration in advance of, and intelligent action taken at, the conventions.

I may be incorrectly informed, but I understand that prior to the Newark convention a rule was adopted by the executive committee for future procedure to the effect that no report will be considered at a convention which has not been given such advance publication to the members of the society. This should do much to protect convention sessions from objectionable movements arising either within or without its active membership.

GEORGE C. WARREN,

President, Warren Brothers Company.

Boston.

Camera on Engineering Work

SIR: I was very much interested in the long article on the use of the camera in engineering work by H. Colin Campbell, which appeared in the Engineering Record of Dec. 2, page 670, and the discussions of the same subject by Messrs. Johnson, Smith and Bintz that were printed in the Dec. 16 and Jan. 27 issues. I am glad you have devoted so much space to this very important subject. I regret, however, that none of the above-named contributors had anything to say about the Autographic camera, which enables one to impress on the film directly at the time of making the exposure



WITH THE AUTOGRAPHIC CAMERA EACH FILM MAY BE PERMANENTLY LABELED, AS SHOWN

the what, the when and the where. It is as handy a camera, especially suited for taking pictures of engineering work, as there is on the market.

The Autographic camera is equipped with a spring door in the back, which is closed by a stop. This little door covers a slot through which one may write, with a hard pencil or stylus provided for the purpose, any information he desires on the red paper protecting the film. Between the red paper and the film is a thin strip of black displacing tissue which serves the double purpose of light-proofing the cartridge and permitting the recording on the film, by light, of the writing on the red paper. When the data have been recorded and printed (by exposing with the door open to the sky, but not the sun, for a second or two) the record is

photographically impressed on the film, and appears when the film is developed. The slot is so located as to bring the title into the margin between the exposures when the film number appears centered in the little red window in the back of the camera. This brings the title at the bottom of an upright, or at the left of a horizontal, negative. Autographic film may be obtained from any photographic dealer.

The advantage of the autographic feature is that every picture can be given a date and a title. By using a code a surprising amount of information may be recorded to supplement that shown in the photograph. If desired, the writing can be impressed on the end of the negative so that it will be included in the picture, as shown in one of the accompanying illustrations, or the entire adjoining film can be used for the purpose.

For making serial records showing the progress of construction work, the autographic feature is particularly useful. The information written at the end of the negative identifies it for all time. By having negatives signed by inspectors, contractors or other responsible persons, controversies can often be obviated. Such a record may also prove an insurance against litigation.

Everyone of your correspondents mentioned above emphasizes the importance of filing negatives properly. The written record on the end of the negative facilitates all filing operations. Mr. Campbell also asserted that a proper record should be made of all attendant facts associated with a picture, especially the time and place of taking and by whom made. If this record is placed on the film instead of in a notebook, which may be lost or misplaced or easily become separated from the negatives, it serves its purpose much more advantageously. All in all, I think the Autographic camera should be in the hands of every up-to-date engineer.

E. A. HUNGER,

Rochester, N. Y.

Eastman Kodak Company.

Unauthorized Use of Photographs

SIR: I notice with displeasure that photographs illustrating my article on the effect of water, the chief factor in the making of concrete, in your issue of Dec. 30, 1916, page 790, had been used to illustrate an advertisement for a commercial product. These photographs have been used without my permission, nor was even the courtesy of a request for them accorded me. Their use in such connection is particularly regretted.

NATHAN C. JOHNSON,

New York City.

Consulting Concrete Engineer.

Damages for Sewage Pollution

Suit was brought against the city of Princeton, Ky., for damages caused by the pollution of a creek by the city sewage. The court was also asked to issue an injunction prohibiting the city from discharging sewage into the creek. The circuit court granted the injunction and awarded \$2,500 damages against the city. The Court of Appeals of Kentucky affirmed the judgment for damages, but the injunction was dismissed, as the court found from the evidence that it was possible to discharge the sewage into the stream in such a way as not seriously to injure owners of property below the sewer outlet.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Boiling Hot Caustic Soda and Cement Mixture Stop Leaks in Concrete

By H. W. STREULI
Schenectady, N. Y.

LEAKS IN CONCRETE can be stopped in the face of running water, even when this is under some pressure, by enlarging the break and properly applying a hot mixture of cement and caustic soda, which sets almost instantly.

Leaks of this kind frequently occur even in the most careful work. Sometimes they result from small defects in the joints between one day's concreting and the next, where a small area has not been perfectly cleaned, or where a low spot in the old concrete retains water used to wash the surface and forms a "honeycomb." Leaks are sometimes produced through no fault of the contractor where the concrete has been placed under extreme temperature conditions without sufficient provision in the way of expansion joints. Slight unequal settlement or shrinkage may also produce leaks.

When leaks develop it is generally too late in any case to remedy the cause, and the only thing left to do is to stop them, sometimes at the expense of considerable money to the contractor and worry to the engineer.

This is often done by piping the flow to one point, grouting in the pipe while it is passing the water, cutting the pipe off within the surface of the concrete and capping it, after which the hole left over the pipe is plastered up. This is a slow, expensive and puttering way of doing the job. Frequently the pipe rusts, discoloring the concrete and sometimes reopening the leak. There is always danger of this if the pipe is exposed to electrolytic action. Leaks may also be calked before plastering with jute, or with lead wool and wood wedges. Jute will only do for small leaks without much pressure, and many engineers do not approve of the use of wood left permanently in the concrete.

To overcome these objections, the method referred to was developed by the writer in connection with other construction superintendents and engineers on sections of the Catskill Aqueduct and Passaic Valley sewer, where leaks which occurred months after the comple-

tion of portions of the work caused considerable trouble. The section of concrete around the leak is cut out to a depth of 3 or 4 in. with a chisel so that the hole is larger at the base than at the surface. A small quantity of fresh Portland cement is then mixed with a boiling-hot solution of caustic soda into a thick paste, which is applied rapidly with the hands (which should be covered with rubber gloves) to one side of the cavity. The plaster is pressed firmly against the old concrete and held for a minute or more. In this length of time it sets very hard and can only be removed with a chisel. This operation is repeated, following around the sides

of the cavity, until a small opening remains, through which the water is now flowing. This small opening is again shaped with a chisel till the bottom is larger than the opening at the surface. Enough freshly mixed paste is then taken in the hand completely to fill this opening, and applied suddenly with one hand, holding the paste in place for a few minutes. If the work has been done well, the leak will be completely closed.

Of course, practice is required for the successful use of this method, and there are several important points to be carefully observed. The soda must be of the best quality and fresh, very concentrated and mixed with very little water. The mixture must be boiling hot when the cement is added, and the latter must also be perfectly fresh.

Very little of the paste should be prepared at one time, as it hardens almost instantly. Just enough of the soda solution should be used to make a stiff paste, which should be mixed very rapidly by kneading it with the hands. The rubber gloves are essential, and anyone attempting to handle the paste without them will certainly regret it.

"Rounding Up the Junk"

IN a Western state a county which has extensive road work under way has established the policy of sending a motor truck from job to job once a month collecting equipment which has been laid aside because of damage or completion of the work on which it was useful. This is called the "monthly roundup of junk"; but it has been found that a very large percentage, perhaps nine-

How About It?

YOU SELL or rent your plant when you finish the job it was bought for and it doesn't fit in on your other work—

Don't you?

YOU LEND a man now and then when you don't need him and another firm wants him badly—

Don't you?

YOU GET AMPLE RETURNS from both these little practices when the other fellow reciprocates—

Don't you?

TRY PASSING ON a few of your bright ideas—that you might not use again in ten years and that may save money for the other man to-morrow—

Won't you?

WHEN THE OTHER FELLOW comes back and tells you what he got up, you can use it—

Can't you?

YES—and there are hundreds of the "other fellow" to one of you!

NO DOUBT OF IT, you'll profit if you keep the ball rolling and send in your contributions to

HINTS FOR THE CONTRACTOR

tents, of this "junk" proves most useful after being put in repair. It is stored in the proper place and listed by the man whose function is to dispatch equipment.

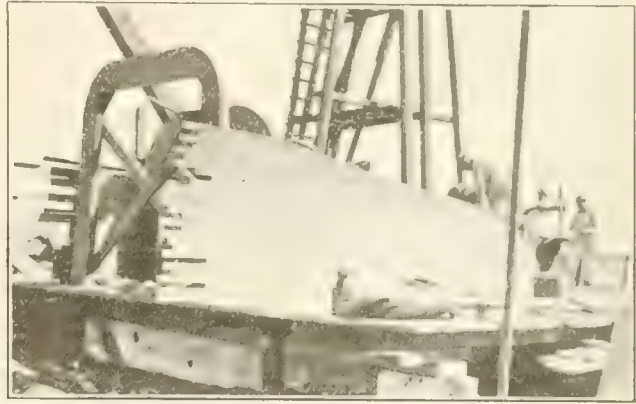
In the rush of construction work it is often better to set aside certain equipment when something else can be substituted with a saving in cost or time. This practice of substitution is a phase of progressiveness and is certainly good policy when properly applied. It cannot be considered good policy, however, to allow equipment to be neglected or abandoned simply because the exigencies crowd it out of service on a particular job. Such loss can be avoided with a system whereby someone connected with the organization and who makes regular trips over the work is assigned to keep a watchful eye open for "junk." Discarded equipment which he finds can be easily noted down, with a memo of the location, and at suitable intervals a motor truck going over the work can call at the specified points and collect the various items listed.

An example of the success of such a scheme was recently afforded in the county referred to when a small pile driver wanted in a hurry was built up entirely from equipment collected in this way.

Large Intake Forms Easily Laid Out When Built in Halves

By C. H. TORNQUIST
Paris, Idaho

BY DIVIDING the form in halves by a vertical plane and building each half with its open side down, the work of laying out and constructing large draft tube or intake tube forms is greatly facilitated. This method, shown in the photographs, was employed in building the intake-tube forms for the Lifton pumping



HALF FORMS EASILY LAID OUT AND BUILT

station of the Utah Power & Light Company at Bear Lake, Idaho, the construction of which was described in the Engineering Record of July 22, 1916, page 98.

The writer has built draft-tube forms as whole units in an upright position upon saddles and found the method very expensive in addition to the difficulty of doing accurate work. By constructing the forms in halves on a platform, however, it is a much simpler matter to lay them out, and also easier to build them, as all parts of the form are readily accessible. The forms were trussed along the vertical plane to counteract the tendency of the lagging to straighten and also to retain the shape of the form when handled by a derrick. The forms were held in position for concreting by supporting the lower end of each form while the upper end was swung from a chain block, the truss work being strong enough to carry the weight. On account of its curved surfaces, this form would seem very difficult to build, but with the method outlined the construction was comparatively simple.

The work on which these forms were used was carried out by the Jarrett-Chambers Company, Inc.

Excavate Mammoth Basement by Railroad Methods

THE REMOVAL of 250,000 cu. yd. of excavation from two city blocks in St. Louis, in which the element of time was an important factor, has recently been accomplished by the use of standard railroad methods. On the site, 254 x 720 ft., at Broadway and Fifth Avenue, is to be located the Bevo plant of the Anheuser-Busch Brewing Company. Following bids for the work, all of which ranged from 85 cents per yard up, a subsidiary of the company took over the work and has completed it at a cost of 41 cents per yard. One of the bidders proposed to put 1000 teams on the job, but the work has been accomplished by steam shovels and standard-gage trains hauling the material a mile away to a dump at the river and Cherokee Street.

As the earth under Broadway was to be removed also to make way for a concrete viaduct, the first operation was to build a temporary wooden trestle, 500 ft. long, over property of the company 50 ft. to the south, to carry the street cars. After the removal of a series of buildings alongside Broadway built in an area formerly excavated down to grade, operations were begun with one of the two 90-ton steam shovels at the northeast,



FORMS SUPPORTED IN PLACE ONLY AT ENDS

corner of the area, extending a shallow 12-ft. cut for a loading track west across the lot and turning to the south along the west side. As soon as this cut was completed the machine was brought back, cars put on the upper tracks and a 32-ft. cut to grade made alongside the loading track. Before this second cut was completed, the second shovel of the same capacity was started on the other side, both shovels working at the same time loading to different trains so that both trains could be pulled out at the same time and not interfere with each other. As soon as the second cut was made a track was placed in it and a third and succeeding cuts started again at the northeast corner. At the height of the work 7000 yd. was removed daily with one 90-ton Bucyrus shovel with a 3-yd. bucket, one Marion with similar capacity, a smaller Bucyrus with a 1½-yd. bucket, and a Thew with a ¾-yd. bucket. Each of the larger machines removed about 3000 yd. daily. An Orton & Steinbrenner locomotive crane with a 1-yd. clamshell excavated trenches for the 4 ft. concrete retaining wall, which is to encircle the whole area, piling the earth and material from the corners where they could be reached by the large machines. A Lidgerwood hoist operating a derrick with a skip from a 35-ft.

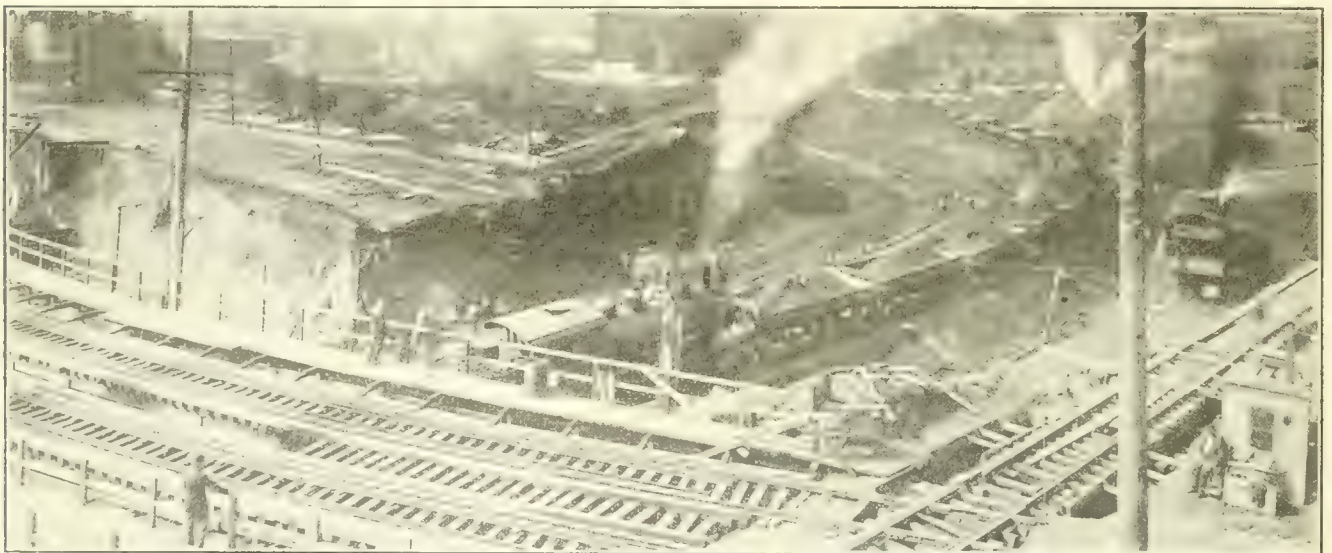
cavation occurring at varying elevations was loosened up after drilling with twelve Sullivan pneumatic drills operated day and night. From one to fifteen holes, drilled 6 to 8 in. below the required grade, were shot simultaneously with 60 to 80 per cent giant powder.

The excavation was started the latter part of September and finished the middle of February. The Gilsonite Construction Company is doing the work. R. P. Dalton is in charge of the excavation for that company and L. L. Peck is superintendent of construction. F. C. Taxis and W. J. Knight & Company are the associated engineers.

Tie Placed Ahead of Rear Truck Levels Cinders Dumped from Hopper Car

By GEORGE A. GIORLOFF
New York City

IN MAKING a cinder fill at the plant of the White Tar Company under construction at Kearny, N. J., the material was spread outside the track by placing a tie across the rails in front of the rear truck of the hopper-bottom car, which was kept in motion while



RAILROAD SHOVELS EXCAVATE BASEMENT IN HEART OF CITY

Temporary trestle in foreground 30 ft. from and parallel to Broadway. Train is on loading track placed first in shallow cut. Single service track for brewery at end of temporary trestle at street grade maintained throughout work.

boom is also used in the excavation of the trenches. About 125 men were employed in this excavation work.

Material was hauled from the site in 100 12-yd. steel Western and Oliver side-dump cars by four standard-gage Baldwin locomotives, 1 mile to the river bank, where a switch track was provided paralleling the shore and the main-line track. No trestle was built, but the track was raised by a force of forty men to the elevation of adjoining land, a Jordan spreader being used during this period. Further dumping was done from the edge of the embankment encroaching on the river. This is to be protected by a concrete revetment.

A concrete wall along Broadway, 20 ft. high and 2 ft. wide, was removed by one of the derricks after breaking up with dynamite. Holes were drilled in the center of the top 5 ft. apart and shot one at a time so as not to damage the temporary trestle. Rock in the ex-

being dumped. The cars were first dumped without using the tie, but the cinders ran out so fast as to block the track and require numerous stops and a great deal of hand shoveling before unloading could proceed. The use of the crosstie overcame this difficulty, the tie tilting up slightly and sliding along the rails, pushing the cinders out at the sides and keeping the rails and the center of the track clear. With the hopper doors wide open the cinders ran out just fast enough to pile up so that a small quantity would spill over the top of the tie. This quantity, however, was not sufficient to block the track, and all the cars unloaded by this method were completely emptied in a few minutes without any stops for shoveling. The tie stood high enough above the rail so that there was no tendency for the truck to ride over it and ditch the car. The contract on which this fill was made is being carried out by T. L. MacBean.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Engineers Qualify as Reserve Officers, U. S. Army

War Department Announces Names of Ninety-One Men Who Have Accepted Army Commissions

Ninety-one engineers have accepted commissions in the Engineer Officers' Reserve Corps, created by the National Defense Act of June 3, 1916, according to an announcement from the office of Brig.-Gen. W. M. Black, chief of engineers, dated Feb. 15. Boards of officers located in the important cities throughout the country are still busily engaged in the examination of applicants, and to date 1200 applications have been received. New applications are reaching the War Department at the rate of almost 200 per month. Blanks to be filled in by those seeking examination may be obtained by writing to the Chief of Engineers, War Department, Washington, D. C.

Newly Appointed Officers

The following is the list of men who had accepted commissions as reserve officers up to Feb. 15:

Majors—William Barclay Parsons, N. Y.; John S. Sewell, Ala.; H. A. Gillis, Wash., D. C.; Ralph D. Mershon, N. Y.; Arthur S. Dwight, N. Y.; Bion Joseph Arnold, Ill.; Frank Sutton, Wash., D. C.; James C. McGuire, N. Y.; Glenn S. Smith, Wash., D. C.; John H. Finney, Wash., D. C.; Arthur M. Waitt, N. Y.; Conway B. Hunt, Wash., D. C.; Frank G. Jonah, Mo.; William F. Dennis, Wash., D. C.; Gardner S. Williams, Mich.; John C. Ostrup, N. Y.; John H. Poole, Mich.; Everts Tracy, N. Y.; Eugene W. Stern, N. Y.; Frederic A. Molitor, N. Y.

Captains—Howard H. Maxfield, Pa.; Arthur A. Reimer, N. J.; Thomas B. Whitted, N. C.; Leon E. Lyon, Va.; Walter C. Allen, Wash., D. C.; Thomas C. Clarke, N. Y.; William M. Lamson, N. Y.; Charles DePuy Robison, N. Y.; Edwin R. Quinby, N. Y.; Chandler Davis, N. Y.; Robert W. Chaffee, Conn.; James L. Taylor, Jr., Pa.; Lawrence E. Curdman, Kan.; John T. Talman, Wash., D. C.; George H. Gifford, N. Y.; Frazer C. Hilder, Va.; Morris F. La Croix, Mass.; George F. Hobson, Md.; Lynn C. Boyatt, Ohio; Isaac S. Matlaw, N. Y.; John P. Hogan, N. Y.; Harry Baker, N. J.; Irving P. Kane, Md.

First Lieutenants—Clifton W. Wilder, N. Y.; Joseph M. Marshall, Jr., N. Y.; Walter H. Meier, Okla.; William Burton, N. J.; Samuel H. Sherrard, N. J.; Diedrich W. Krellwitz, N. Y.; William Hague, Cal.; Arthur C. Forbes, N. Y.; Maurice R. Scharff, Pa.; Clifford L. Harrod, Pa.; Edward B. Snell, N. Y.;

To Subscribers for the Engineering Record

Subscriptions for the Engineering Record will be continued automatically as subscriptions for the Engineering News-Record after the consolidation with the Engineering News takes place April 5. Where both papers have been subscribed for, the unexpired terms of the two subscriptions will be added together and applied on the Engineering News-Record. In other words, readers will get for the unexpired terms of their subscriptions the greatly increased value that will result from the consolidation of the two papers.

Tentative Plans for New Freight Terminal in San Francisco

Tentative plans have been announced by the Southern Pacific Railroad for the channel and waterfront improvement in China Basin at San Francisco. The railroad recently acquired this property through an exchange of real estate with the city.

The channel is at present 140 ft. wide. The plan is to widen it to 300 ft., with a minimum depth of 35 ft., and to build large warehouses on the north side where the company now has the terminal of the coast rail lines. In the ultimate development the terminal will cost about \$10,000,000, according to an estimate made by the company's engineers.

Improvements Required

A new single-lift bascule bridge would be required across the channel at Third Street, the clear opening of which would be 120 ft. Lift bridges would also be required at Fourth and Sixth streets. About 7500 lin. ft. of bulkhead would be necessary around the edge of the dredged area.

The warehouses, according to the tentative plans, would be 800 ft. long and six to eight stories high. The main floor, arranged for the convenient transfer of freight, would have a depressed truckway for teams and adequate trackage, while upper stories of the buildings would be leased for warehouse purposes. The original plans for the development were drawn up by Howard C. Holmes, consulting engineer, of San Francisco.

McGraw and Hill Publishing Companies Consolidate

Eleven Leading Technical Papers Brought Under One Administration—Engineering Record and Engineering News to Consolidate

The McGraw Publishing Company Inc. and the Hill Publishing Company have been consolidated as the McGraw-Hill Publishing Company, Inc. The new company acquires all the properties and interests of the two constituents, including the following technical journals:

Engineering Record, Electrical World, Electric Railway Journal, Electrical Merchandising, Metallurgical and Chemical Engineering, The Contractor, American Machinist, Power, Engineering News, Engineering and Mining Journal, and Coal Age.

Two of these papers, Engineering News and Engineering Record, will be consolidated under the name Engineering News-Record. E. J. Mehren, editor of the Engineering Record, will become vice-president and general manager of the McGraw-Hill Publishing Company. Charles Whiting Baker, now editor of Engineering News, will act as editor-in-chief of the Engineering News-Record.

James H. McGraw will be president of the new company and Arthur J. Baldwin, now president of the Hill Publishing Company, vice-president and treasurer.

Propose Municipal Engineering Short Course

An annual short course in Municipal Engineering at the University of Texas at Austin, to be conducted under the auspices of the Engineering Department, was proposed at a recent meeting of city engineers of the state, at Austin. The proposition met with approval and will probably be put into effect.

Growth of Testing Materials Society Continues

Notwithstanding the increase of 50 per cent in dues which became effective on Jan. 1, 1916, the growth in membership of the American Society for Testing Materials has been well maintained, the net increase for 1916 being 171 as compared with 208 for the previous year. The present total membership is 2132, which represents a net increase of 62 in comparison with the figures reported at the last annual meeting in June. There is every indication that the increase in dues will result in only a slight and temporary impairment in the growth rate of membership.

Wisconsin Society Shows Healthy Growth

In 1915 a handful of Wisconsin engineers voted on the question of disbanding the state organization, but at the last convention, held at Madison, Feb. 15 and 16, there was an attendance of more than fifty engineers. The membership has increased to 166, and the treasurer reported a surplus of \$508.50. The diversity of the membership, segregated by the secretary, Prof. L. S. Smith, is as follows: Highway engineers and commissioners, 13; city engineers, 27; consulting engineers, 24; miscellaneous civil engineers, 16; architects, 5; mechanical and electrical engineers, 12; contractors, 17; salesmen, 32; miscellaneous, 20.

For the benefit of contractors, standardized plans and profiles for municipal work were suggested in the annual address of J. S. McCullough, city engineer of Fond du Lac and president of the society. The legislation committee recommended that all surveyors be placed on the same footing with the county surveyors, who are now required to file plats and complete data of land surveys at the county courthouse. At present land surveys are not recorded unless the work is done by the county surveyor. Methods used in evaluating the Chicago Elevated were outlined by F. J. Bachelder, consulting engineer, Chicago, who has just finished the work for the Subway and Traction Commission.

Esthetic considerations in bridge design by Prof. W. S. Kinne elicited one of the most spirited discussions. Some of the suggestions were: Make structures conform to the surroundings; design end spans of a bridge, if materially smaller than the main spans, of a different type, so that they will not appear like "samples" of the real spans; eliminate a pier at the center of bridge by choosing an odd number of spans; separate different types of spans by a tower or gateway.

Professor Smith read a paper on "What City Planning Can Do for Wisconsin Cities." Prof. George R. Bascom, extension department, University of Wisconsin, has been studying the relation of street dust to disease through cultures taken and examined in various cities. He is of the opinion that dust is not nearly so injurious as is generally thought. However, Doctor Hanneke, State Board of Health, disagrees with this view, holding that the mechanical irritation of dust predisposes one to bacterial infection. The paper on monolithic brick pavements by W. T. Blackburn, was freely discussed because few, if any, pavements of this type have been laid in the state.

Front Cover Picture

The front cover picture of this issue shows a "hook-on" connection on a log flume now being built on Mica Creek, a tributary to the St. Joe River, Idaho. It was furnished by the contractor, Vincent K. Woods, of Missoula, Mont.

Engineers Qualify as Reserve Officers, U. S. Army

CONTINUED FROM PAGE 363

Howard H. George, N. J.; Morgan T. Coakley, N. Y.; Raymond J. O'Brien, N. Y.; Harry T. Griswold, Conn.; G. August Schneider, Ind.; Jacob Schlesinger, Md.; Edward King Carley, N. J.; Earle P. Gray, Ohio; Albert F. Edel, N. Y.; Hugo C. Soest, N. Y.; James F. C. Hyde, Mich.; Julius R. Wemlinger, N. Y.

Second Lieutenants—Claude A. Latimer, N. Y.; Charles N. Bell, Pa.; Frederick W. Toerner, N. Y.; Ralph Eberlin, N. Y.; Francis E. Schanker, Pa.; Alexander W. Yereance, N. J.; Alexander X. Schroeter, Kan.; S. Dole Ashford, Conn.; F. Russell Lyons, Washington, D. C.; B. B. Anderson, Pa.; John H. Wilson, Washington, D. C.; Edward T. Collins, Conn.; William H. Griffith, Ohio; John M. Arovitch, Pa.; Samuel B. Balland, N. Y.; Frank C. C. Johnson, N. Y.; Merrifield G. Martling, Mo.; Paul J. Ploss, Pa.; Charles M. Anderson, N. Y.; Raymond P. Pennoyer, Pa.; George H. Schlotterer, Jr., N. J.; Harry B. Collins, Mass.; Walter P. Burn, N. Y.; John B. Cuno, N. Y.; Frederick U. Conard, N. Y.

Officers' Duties Outlined

With the list of names received from General Black was the following outline of the duties of reserve officers and qualifications for commissions:

In war operations, the engineer branch of the Army is required to furnish officers for duty, first, with the forces at the front and, second, on lines of communication in rear of the front, or for special services in other localities. The two services are co-ordinate and of equal importance, but for purposes of classification in the records, examining boards are required to recommend candidates for one class or the other. On account of the fact that the first class, designated Class A for convenience, will presumably be needed first for service with the mobile Army, candidates for the higher grades—that is, Captain or Major—are examined in military subjects. As there will be more time for the military training of the second class—Class B—no examination in military subjects is required. In actual service, those in Class B may be used for services usually required of Class A, and in commissions of officers no distinction is made.

Qualifications

The qualifications of engineers who are wanted for commission in the Engineer Officers' Reserve Corps, together with some of the duties required of them, are as follows:

(a) *Civil Engineers*—This class includes: General construction engineers, for the design, construction, and maintenance of earth and concrete fortifications, wharves, piers, and buildings of all kinds; highway engineers, for the

layout, construction and maintenance of roads and trails on lines of communication or in other localities, including highway bridges of all kinds, ferries, fords, etc.; sanitary engineers, for the design, construction, maintenance and operation of waterworks, sewage-disposal plants, etc., in connection with camps or localities occupied by troops within the zone of operations; topographical engineers, for making maps of all kinds within the actual or probable zone of operations and the training of topographical units for the front, including all kinds of map reproduction, especially photolithography.

(b) *Electrical Engineers*—This class will be required for services such as the following: Design, construction, maintenance and operation of electric railways forming a part of the lines of communication, including the power plants connected therewith, the installation and operation of electric plants at seacoast fortifications and such power plants as may be needed on the lines of communication, the operation and maintenance of searchlights and other electrical equipment used in the protection of places on the lines of communication or other places not at seacoast fortifications, the training of troops in the care and operation of searchlights for the service at the front, the repair of searchlights and other electrical equipment used by troops at the front.

(c) *Railroad Engineers and Operating Officials*—This class requires all those engineers and operating officials ordinarily included in the organization of a commercial railroad system, including engineers for the location and construction of track, bridges, stations, etc.; engineers and officials for the maintenance of same, including wrecking operations; operating officials, such as general managers, superintendents, etc.

(d) *Mechanical Engineers*—This class will be required for such services as the installation and operation of machine shops for the maintenance and repair of railroad or other engineer equipment used on the lines of communication and for the design, maintenance and repair of engineer equipment used by the combatant troops at the front, including the field railways.

(e) *Mining Engineers*—This class will be required for such services as the construction of fortifications on the lines of communication or other places removed from the front, and in the training of troops for service at the front in sapping and mining operations, and in use of explosives.

Denver Engineers Survey State

A group of engineers of the Denver Civic and Commercial Association has undertaken a survey of Colorado's resources as to technical men and materials needed in military preparations. Prof. L. G. Carpenter, consulting engineer and chairman of the group, has announced a series of meetings to perfect plans.

Indiana Waterworks Men Discuss Problems

Analyze New Business Methods, High Cost of Chemicals and Standard Fire-Hose Thread Changes

A part-payment method of getting new business, the high cost of chemicals and a demonstration of cutting standard hose threads on fire hydrants were features of the meeting, Feb. 14 and 15, of the Indiana Sanitary and Water Supply Association, held at Indianapolis. The registration roll reached 170.

R. A. Butler, publicity expert, and F. C. Jordan, secretary of the Indianapolis Water Company, made public for the first time a part-payment plan which the company has been investigating for several months. The method consists of the organization of a funding company, presumably as a subsidiary to the water company, for the purpose of financing the installation of sewer and water connections and plumbing fixtures for people of good credit but too poor to bear the immediate costs of such installations. The detail plans in common use by the gas and electric companies were favored. Although the field consists of the one-third of the whole population not now served by the water company, the scheme has more than local application, for this 30 per cent figure holds good as an average throughout the state, according to investigations of both the State Board of Health and the U. S. Public Health Service.

Advance in Purifying Chemicals

The chemical cost problem was presented in an instructive report by Philip Burgess, consulting engineer of Columbus, Ohio, who is chairman of the committee on water purification. From a questionnaire to the twenty-three plants in the state using chemicals, he learned that the average quantity of hypochlorite applied during 1916 was 8.5 lb. per million gallons, at a cost of 5.3 cents per pound. The average for liquid chlorine was 1.8 lb. at 16 cents per pound. Sulphate of iron costs, ranging from \$10 to \$24 per ton, have been determined largely by the price which the market would stand, being influenced largely by the increase in alum costs. Lime fluctuated less widely, \$5.65 to \$9.44 per ton being the cost for hydrated lime. At Columbus, Ohio, C. P. Hoover is manufacturing alum for the water purification plant. The cost was \$7.20 per ton in 1915, but in 1916 the high price of acid raised the figure to \$20.08.

Development of dry-feed machines for the application of chemicals is progressing rapidly, Mr. Burgess stated, especially in plants using lime and iron. A satisfactory type is a helical conveyor in the bottom of a hopper. He stated that a 4-in. conveyor would discharge daily 3000 lb. of sulphate of iron or 1000 lb. of hydrated lime when operated at 1 r.p.m.

The thread-cutting demonstration

was staged in front of the water company's office, an ordinary hydrant nipple of eight threads to the inch being chased down so that a standard 7½-thread coupling would fit. A fireman who was present was not entirely satisfied with the demonstration, for the coupling chattered while being put in place. However, a test of 500 lb. per square inch which broke the hose failed to blow off the connection. It was stated that old nipples could be chased down at a cost of 30 cents apiece, while new nipples would cost several times as much. The demonstration was doubly interesting in view of the fact that a bill at present before the state legislature requires every connection to be made standard.

Want Standard Fire-Hose Couplings

J. B. Marvin, superintendent of waterworks, Frankfort, in his paper on fire-fighting methods in Indiana, called special attention to a recent disastrous fire at New Castle, at which hose brought in from Muncie was useless on account of the non-conformity of threads in the couplings. Of the 210 water systems in the state, it was computed that 95 per cent could be adapted to take standard couplings without change. Paul Hansen, chief engineer, Illinois State Board of Health, presented a paper on the practical aspects of State control of water supply and sewage disposal. Three fundamental considerations were laid down: get the maximum amount of health and sanitation possible from money spent; distribute expenditures equitably over the State; give local governments and agencies the maximum latitude possible in meeting their own problems in their own way, consistent with the welfare of the State as a whole.

Round-Table Discussions

Four round-table discussions were held, each being restricted to one hour. F. C. Jordan presided over the one on surreptitious use of water. Dow R. Gwinn called it plain stealing, and laid particular stress on illicit tapping of private fire lines. William Luscombe, of Gary, in leading the discussion on meter-department operation, stated that a special man was employed to notify consumers of excess meter reading. A handbill, warning patrons to care for the meter in cold weather, is sent out with December bills. It costs 0.2 cent to deliver bills, but gas and electric bills are sent by the same man.

Uses Post-Card Water Bills

"In Indianapolis," said W. G. Ulrich, "there are 5000 meters out of 38,000 connections in an area of 90 sq. miles. It requires five readers eight days to make readings. If the reading is high, the reader takes time to go over the fixtures. The postal-card bill is used and a stub is cut, the receipt end being returned in a 2-cent envelope. Postal regulations are observed as to size in sending out bills in 1-cent envelopes." J. A. Craven, Terre Haute, outlined a scheme of rivalry by which the readers of the thirty-five meter books are

spurred on to reduce the time of readings.

The officers elected for the coming year are as follows: President, W. F. King; vice-presidents, J. W. Toyne, A. L. Fields, R. B. Wiley, Philip Burgess and Howard Ely; secretary-treasurer, W. G. Ulrich, Indianapolis, assisted by J. A. Craven.

Iowa Engineers Adopt Minimum Standard Fees

Proposed Engineering License Bill Segregates Classes and Exacts Merely Nominal Fee

Standard minimum fees to be charged clients for professional services were adopted by the Iowa Engineering Society at its meeting Feb. 21, 22 and 23 at Ames. A per diem rate of \$25 and expenses was held proper for consultation. Municipal engineering is held to be handled best on a percentage basis. Including inspection, engineers should charge at least 5 per cent for paving, 8½ per cent for sewers and 6 per cent for water and light plants.

Fees Are Graded to Service

J. H. Mayne, consulting engineer, Council Bluffs, as chairman of the committee on professional ethics and standard fees, brought in the report containing these standards. The fees were named mainly for the guidance of official bodies when considering the employment of an engineer. For services of a preliminary nature, including estimates, reports, etc., 1½ per cent of the cost is to be the minimum. If there is also included the preparation of the drawings, specifications and contract, and all work up to the letting of the contract, 2½ per cent is to be charged. If the engineer is asked to go still further and handle the letting of the contract and have consulting supervision of the work, then 5 per cent is to be received; while if he goes still further and takes full responsibility for the inspection and construction, including all engineering, the cost is to be 6 per cent.

Charles P. Chase, in discussion, succeeded in raising the figure for sewers from 7 per cent to 8½ per cent. In his twenty-five years' experience he has found in many cases that the former figure would leave no margin of profit.

For a License Bill

In the license bill which the committee on that subject, headed by T. S. DeLay, was authorized to present to the present legislature, civil engineers or surveyors must be licensed, for the branch of the profession under which their practice is classified, by a state board of three examiners to be appointed by the governor from a list furnished by the Iowa Engineering Society. The board is to be sustained from the fees collected from engineers. A secretary at \$3000 per year is provided, the board members to receive \$10 per day and expenses for the time actually spent. License money is to be

held as a separate fund, and the total amount of the warrants must not exceed the fees paid in. After the first year all candidates are to pay \$10, but for the first year after the enactment of the bill those actively engaged in engineering for at least five years and in responsible charge for one year may be given licenses on payment of \$3. The license will permit practice in any one or more branches of engineering which the record of their experience shall indicate they have qualifications. Engineers may acquire the right to practise in additional branches by the payment of an additional \$3 and by submitting satisfactory proof of ability. An annual renewal fee of \$1 is to be exacted. Punishment for violation of the act consists of fines of from \$100 to \$500, or imprisonment for three months, or both.

Charles P. Chase, in his talk on "Co-operation of Engineers in Iowa," held that the society secretary ought to maintain a service clearing house for employer and employee. The consulting engineer frequently has a hard time keeping his men over winter, and he felt that probably some one else might need and be able to use such men.

Unionism Up to Employing Engineers

The "continuity of service" problem was touched upon again by H. J. Burt, president of the Western Society of Engineers, who gave the banquet address on "The Engineer of To-day." He held that the responsibility for its solution rests on the employing engineers and that it would be most unfortunate if the principles of unionism should be invoked by a set of employees from whose ranks are to be taken men for positions requiring the utmost fidelity. As unionism has already started in Chicago, he cautioned his hearers to think it over and to consider whether they were doing their part to prevent its spread.

Prof. A. W. Hixson, Iowa State University, presented the results of a series of experiments showing the detrimental effect of overheating asphalt both as to physical and chemical properties.

The officers elected for the coming year are as follows: President, Keyes C. Gaynor; vice-president, C. T. Wilson; secretary-treasurer, J. H. Dunlap, Iowa City; directors, C. H. Currie and H. H. Dean.

Begin Work on Sixth Au Sable Hydro-Electric Plant

The sixth hydro-electric development plant on the Au Sable River has been started by the Commonwealth Power, Railway & Light Company. This plant will have a capacity of about 11,000 horsepower. The Commonwealth's fifth hydro-electric plant on the Au Sable, known as the Foote development, is now in the process of construction, and will have a capacity of 12,000 horsepower. The sixth of the Au Sable plants will be completed by the end of the present

Military Training Urged Upon Engineers

The desirability and necessity of compulsory universal military training is being urged upon the members of the five national engineering societies by a printed folder signed by sixteen of the nation's most famous engineers. The folder, which is addressed to the members of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Consulting Engineers, says in part:

"We know most engineers realize that compulsory training and service are not only desirable but absolutely necessary for the welfare and safety of our country. We feel sure that those of you who are not already firmly of that conviction will become so after having given the subject a little careful thought.

"Believing that all of you are not only ready but anxious to render such service to our country as lies within your power, the undersigned earnestly request that each of you send personal letters, or telegrams, to the Representative from your district, and to each of the two Senators from your State, to the following effect, but preferably in your own language:

"I urgently request you to support and vote for the plan covered by Senate Bill S-1695, reported by Senator Chamberlain Feb. 10, 1917, providing for compulsory military and naval training and service; preferably with such modification of it as may be recommended by the General Staff of the Army, and the General Board of the Navy." The folder gives the essential features of the bill in brief form.

The following signers, although members of one or more of the societies addressed, act as individuals in making the request: Bion J. Arnold, W. F. Durand, Thomas A. Edison, J. D. Galloway, George W. Goethals, W. F. M. Goss, Alexander C. Humphreys, A. M. Hunt, E. C. Jones, W. S. Lee, Ralph D. Mershon, William Barclay Parsons, M. I. Pupin, Charles F. Rand, J. Waldo Smith, John F. Stevens, L. B. Stillwell, George F. Swain, W. H. Wiley and W. J. Wilgus.

New Jersey Proposes State Highway Commission

A bill to be introduced in the New Jersey legislature provides for a State Highway Commission consisting of eight men, to replace the present commissioner. These men will serve without compensation and will appoint the State Highway Engineer, who will have complete charge of administering the department. The present plan is to ignore the Egan Bill, which provides for a \$7,000,000 bond issue, and to pass another bill providing for the levy of a special tax for road purposes.

The bill proposes to raise \$3,000,000 a year for a period of five years. In ad-

dition to this, automobile license fees and fines will be spent on repairs and reconstruction. This means that about \$25,000,000 will be spent on New Jersey roads in the next five years if the proposed measure goes through. The work will be done by the State Highway Department and not by individual counties as at present.

Water Power Bill Revived in Congress

The House of Representatives has rescinded its action of last week when it voted to discharge its conferees on the general dam bill upon which they had reported, since there seemed no chance of an agreement between the House and Senate.

President Wilson and Representative Adamson have had a number of conferences on the bill, and President Wilson has favored water-power legislation at this session of Congress. The result of the rescinding of the House action means that there will be another attempt of the Senate and House conferees to get together on the bill, as the Senate did not discharge its conferees when they reported no agreement.

The general dam bill, in different forms, passed both houses of Congress at the last session. There is now a prospect that the bill will be passed at this session of Congress.

Engineers Entertain Concrete Institute

With co-operation as its watchword, the American Association of Engineers tendered a banquet to the American Concrete Institute last week. From the time the coffee-cups were pushed back and cigars lighted to the end of the program not an uninteresting minute passed. Presided over by W. H. Finley, chief engineer of the Chicago & Northwestern Railway, and with Richard Henry Little of the Chicago *Herald* as toastmaster, each of the seven speakers held the attention of the listeners without difficulty. Walter L. Fisher, former Secretary of the Interior, gave a masterly exposition of the nature of the League to Enforce Peace.

Delayed Blast Causes Fatal Accident in Twin Peaks Tunnel

A gang of workmen engaged in blasting rock in the Twin Peaks tunnel at San Francisco returned to work after a round of shots had been fired on Feb. 15 and were caught by a delayed explosion. Twelve charges had been placed, the fuses ignited, and from a place of safety the shots were counted as they exploded. One missed fire, but was lost in the count, it being taken for granted that it had exploded simultaneously with one of the other shots. After the usual wait, the gang returned to work, and just as they reached the spot the delayed explosion occurred, killing the foreman and one laborer, seriously injuring two, and causing lesser injuries to five others.

What Engineers and Contractors Are Doing

B. F. CRESSON, JR., retired March 1 as chief engineer of the New Jersey State Board of Commerce and Navigation and became consulting engineer to the board. Mr. Cresson proposes to enter private practice as a consulting engineer, with offices at 50 Church Street, New York City. Until May 1, however, his temporary offices are 30 Church Street.

WADDELL & SON, consulting engineers, Kansas City, Mo., have opened a branch office in the City Investing Building, 165 Broadway, New York City. Mr. F. H. Frankland, as noted in last week's issue of the Engineering Record, will be in charge of the office. Dr. Waddell will divide his time between the two offices.

W. A. BOUVE is at present engineer for the General Chemical Company at the Bay Point plant, Bay Point, Cal. For the last year Mr. Bouve has been construction engineer with the Associated Pipe Line Company in charge of construction of two oil-pumping stations on the line from Bakersfield to Porta Costa. Previous to 1916 he was employed by the Southern Pacific Company as field assistant for one year, by the Associated Oil & Pipe Line Companies as draftsman, computer and foreman, for two and one-half years, and by private engineers as computer and transitman on subdivision and sewer work for a period of two and one-half years. His experience in the last four years has been mainly factory construction work.

H. C. VENSANO announces his resignation as civil and hydraulic engineer of the Pacific Gas & Electric Company and his association with John R. and Edward G. Cahill, general contractors, under the firm name of Cahill-Vensano Company, contracting engineers, 460 Montgomery Street, San Francisco, Cal.

ROBERT C. WHEELER, city engineer, Summit, N. J., has resigned.

MARC P. TAYLOR has been appointed resident engineer at Madison, Mo., for the Chicago, Burlington & Quincy Railroad. Since graduation from the University of Illinois, in 1913, Mr. Taylor has been in private work and also in the employ of the railroad at the Chicago offices.

ROBERT GAW, North Bergen, N. J., has been appointed engineer for the Boulevard Commission, Jersey City, N. J., to supervise all work in connection with the Hudson County Boulevard, succeeding Frederick Dunham.

FRED E. WILSON has been appointed city engineer of Marion, Ind. Mr. Wilson, who is a graduate of Purdue, has had five years' experience in construction and maintenance work with the Northern Pacific Railway and the Chicago, Milwaukee & St. Paul Railway.

PAUL P. WHITHAM, consulting engineer, Seattle, Wash., has been appointed federal trade commissioner to investigate port and transportation facilities in Russia and the Far East. Mr. Whitham was chosen commissioner out of several hundred applicants from all parts of the United States. After successfully passing a series of examinations he was selected as one of a group of fifteen engineers to go to Washington, D. C., and take the final examination. In this test he ranked the high-

Appointed Federal Trade Commissioner



Photo Meredith Studio, Seattle, Wash.

PAUL P. WHITHAM

est and was awarded the post. In line with the development of the foreign trade of the United States in the Far East Mr. Whitham is to make a careful survey of conditions and submit a report to the Bureau of Foreign and Domestic Commerce on his findings. The tenure of his office is indefinite. Mr. Whitham, who was formerly chief engineer of the Port Commission of Seattle, resigned about two years ago to enter private practice. During his connection with the Port of Seattle he took a leading part in designing Seattle's new port facilities, and is regarded as one of the most capable port engineers of the country.

ROURKE & SHERMAN, consulting engineers, Boston, Mass., have dissolved partnership.

JOHN A. BARHITE, of Rochester, N. Y., has been appointed a member of the New York State Public Service Commission, Second District, in place of D. P. Hodson. Mr. Barhite has been a county judge for eleven years.

JOHN ROBERTS has been appointed borough manager and engineer for Bristol, Pa., effective Feb. 1.

The following appointments for members of the Delaware River Bridge and Tunnel Commission have been made by Governor Edge of New Jersey; Thomas J. S. Barlow, Burlington, re-appointed; R. T. Collins, Camden, succeeding Issac M. Griscom, and Daniel F. Hendrickson, Gloucester, succeeding C. R. Budd.

F. VAN Z. LANE, executive engineer and traffic expert for the city of Bayonne, N. J., has resigned to accept an appointment as manager for the Jersey City Chamber of Commerce.

W. O. HANDS, for twenty-three years in the civil engineering department of the Kansas City Railways Company, has opened an office in the R. A. Long Building, Kansas City, Mo., where he will conduct a general engineering practice.

S. L. MILLER has left the employ of the Illinois Highway Department at Springfield, Ill., and is at present engaged on pier-protection construction work for the Wabash Railroad at Hannibal, Mo. Mr. Miller may be addressed at Box 25, Hannibal, Mo.

L. D. HOWLAND is construction engineer with the Great Western Electro-Chemical Company at Pittsburg, Cal. Prior to his present position, Mr. Howland was for three years with the State Water Board of Oregon as division engineer and for two years was county engineer of Union County Ore. Mr. Howland is at present connected with the enlargement of the \$400,000 plant of the Great Western Electro-Chemical Company.

JOHN T. GEPHART, JR., formerly construction engineer of the Pennsylvania State Highway Department, has been appointed road engineer for Fayette County, Pennsylvania.

J. F. GREENE has resigned his position as bridge engineer in charge of the design and construction of the Centre Street Bridge, Calgary, Alta., Canada, and has entered the employ of the Carter-Halls-Aldinger Company, Ltd., engineers and builders, Union Bank Building, Winnipeg, Canada, where he is in charge of the underpinning of the Grain Exchange Building in Winnipeg. Prior to entering the employ of the city of Calgary as bridge engineer in 1914, Mr. Greene was bridge engineer for the city of Spokane, Wash. While in this position he had charge of the design and construction of the Monroe Street concrete bridge costing \$500,000.

H. P. NILES, engineer Drainage District No. 5, Snohomish County, Washington, has resigned his position.

JOHN R. DONALDSON is now located in the bridge office of the Illinois Central Railroad. Since graduation from the University of Illinois in 1916 he has been employed as assistant in the office of the County Superintendent of Highways at Urbana, Ill.

BRADFORD-ACKERMANN CORPORATION, with offices in the Forty-Second Street Building, New York City, is announced by A. H. Ackermann, formerly vice-president and general manager of the U. S. Light & Heat Corporation, and C. C. Bradford, formerly sales manager of the same company. The new firm will represent manufacturers of electric apparatus, factory, automobile and railway supplies for domestic and export trade. Correspondence with reliable manufacturers is invited.

E. J. COOK, general manager of the New York State Railways, Rochester lines, has been appointed chief engineer of all lines of this system, which include the city lines in Rochester, Syracuse, Utica and Schenectady, the third-rail line between Syracuse and Utica, and half of the interurban line between Schenectady and Albany.

Obituary Notes

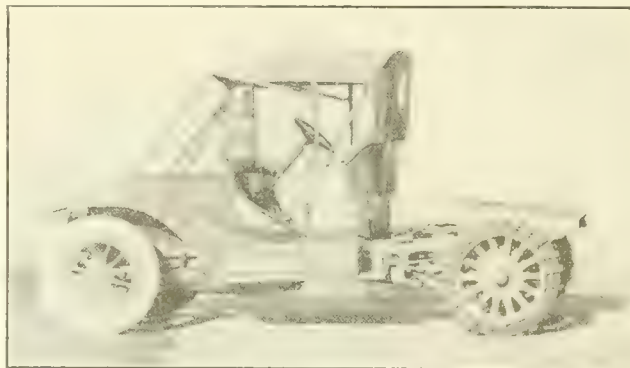
WILLIAM E. HAMLIN, civil engineer, said to have been one of the four or five men who submitted bids for constructing the Panama Canal, died Feb. 13 in Pasadena, Cal., where he had resided during the last five years. He was 44 years of age. Mr. Hamlin was born in Boston and attended Massachusetts Institute of Technology. From 1893 to 1898 he was in charge of city surveys for the Boston Water Department and of tidal observation and triangulation work. Later he constructed different roads and sewers and was engaged on pile and foundation construction. In 1902 he went to Venice, Italy, to estimate the cost of rebuilding the Campanile tower and to make a study of the Italian cement industry. In 1903 he was with F. B. Gilbreth, engineer, contractor and manufacturer, as chief civil engineer in charge of the New York office. Later he forsook contracting and engineering pursuits and went to California to develop and manage his property there, where he was owner of a large tract of land near Red Bluff.

GEORGE ROSS, senior partner of the Ross Valve Manufacturing Company, died Feb. 9 at the age of 88 years.

WILLIAM O. HENDERER, president of the Osborn Engineering Company, Cleveland, Ohio, died Feb. 8 at Miami, Fla. Mr. Henderer had been connected with the company since 1897, and up to 1900 was in direct charge of design of viaducts, bridges and buildings and of the inspection of bridges for six different railroads. Later he was active as vice-president and director of the company, and still later as its president. Mr. Henderer studied at Rensselaer Polytechnic Institute and up to the time of his association with the Osborn Engineering Company enjoyed a general engineering practice in design, fabrication and erection of many steel and concrete structures, among them the Brooklyn-Brighton viaduct.

Design Three-Ton Tractor Unit

A tractor unit which may be used with a dismantled pleasure car to produce a 3-ton tractor has recently been put on the market by the Knox Motors Associates, Springfield, Mass. The new unit, which is sold at \$550, is attached by first stripping the body from the rear as far forward as the back of the front seat and removing the rear axle and springs. The cross-channel of the traction unit is placed over the stripped frame, which may be of any width, is



TRACTOR UNIT USED WITH DISMANTLED CAR

squared up, and after drilling for the necessary connections may be bolted into place. The propeller shaft is connected to the axle by means of a special universal joint flange furnished with each unit. The new tractor is said to combine low capital investment and low maintenance cost, and is designed to afford an outlet for used pleasure cars.

Advantages Claimed for Floor Filler Tile of Gypsum

Filler tiles of gypsum for use in constructing concrete floors have recently been put on the market. The tiles are hollow, having reinforced walls 1 in. thick at the sides and $\frac{3}{4}$ in. thick at top and bottom. The top edges are rounded to eliminate sharp corners at the junction of floor and T-beams. A spacer of gypsum, 1 in. thick, is used between tiles at joists. This aligns the tile and also prevents the concrete from coming in direct contact with the



GYPSON FILLER TILES ARE EASILY CUT FOR PIPES

forms. Thus the tiles are 1 in. deeper than the concrete joists, and an all-gypsum ceiling surface is left after the forms are removed.

Some of the claims made for the tile by the maker, the U. S. Gypsum Company, are as follows: They are sufficiently strong for wheeling and similar working operations which must be conducted over the tile during the pouring of concrete, since a 6-in. tile under test carried a load equivalent to 664 lb. per square foot. This strength makes possible a thinner concrete floor slab. As the ends are closed and the sides fit closely, there is no appreciable waste of concrete. Form work is reduced to a minimum. Holes for piping and conduits are easily bored or cut in the tiles, and in 12-in. joists there is a saving in the "dead load" of 20 lb. per square foot. A material increase in the strength of the concrete is claimed since the gypsum prevents it from drying out too quickly. Concrete

set in contact with a wetted tile gave crushing-strength values at 7, 28 and 90 days of respectively 16, 17 and 40 per cent in excess of concrete set without floor tile. The tiles are made of Structolite gypsum, which is not weakened by exposure to the elements during construction.

The manufacturer of this tile has been developing the uses to which gypsum can be put. Several of its products are well known and have met with a favorable reception, among them a reinforced tile roof deck for which they claim a combination of unusual lightness and adequate strength.

Building Methods and Materials on Exhibition

From March 5 to March 11 inclusive the Second National Complete Building Exposition will occupy the Grand Central Palace, New York City. Here the manufacturer, architect, contractor and prospective builder will get together for the exchange of ideas and to get acquainted at first hand with the recent developments in construction methods and materials. Extensive exhibits of structural steel, cement products, brick, architectural and structural terra cotta, limestone, marble and lumber have been planned by the various dealers and manufacturers, and there will be shown examples of special types of construction, fire-resisting metal window frames and sash, wire glass, expanded metal products, partition construction, ventilating and plumbing systems, elevator installations, and the better forms of construction toward which public sentiment is so rapidly turning.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MC GRAW-HILL PUBLISHING COMPANY, INC.

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Number 10

McGraw-Hill Consolidation

LAST week we commented briefly on the coming consolidation of Engineering Record and Engineering News, but recorded in a news note only the larger merger—that of the McGraw Publishing Company, Inc., with the Hill Publishing Company. To the readers of the Engineering Record the News-Record consolidation is of the greater direct interest, yet the influence of the union of the two big publishing properties will have a great and beneficial influence, not only on the Engineering News-Record, but on the whole field of engineering. For the first time there is represented in one great publishing house strong magazines in each of the five major fields of engineering. The McGraw company had papers in the civil, electrical and chemical engineering fields; the Hill company in the civil, mechanical and mining fields. Now all the journals are in the McGraw-Hill Publishing Company, Inc. What this means to the entire profession is obvious. The editors will be brought close together and will bring to the common council the views of each branch of the profession. The readers of each journal are, therefore, assured of the most comprehensive views of big issues. There are other and not a whit less important benefits. The large number of papers to be served will make it possible to organize the country editorially in a very efficient way, insuring a service to readers that even the constituent companies, strong as they were, found it impossible to render. Then the number of fields represented introduces a stabilizing diversity factor that will insure the maintenance of an unparalleled service in all the journals, despite adverse financial conditions in one or two fields. And even as the editors of the Engineering News-Record recognize their responsibility in speaking each week to 75,000 or 100,000 engineers and contractors, so do the publishers recognize their larger responsibility to the entire engineering field. They have confidence that their ideals are understood by the engineering world. Papers like Power, Engineering and Mining Journal, Electrical World, Engineering News and Engineering Record have written themselves into the histories of their respective fields. The old ideals of these journals—so religiously adhered to through a generation—will be upheld.

Canadian Engineer-Soldiers

FOREIGN PAPERS bring the news of the human toll that the war is taking from the engineering profession. The English papers tell the story in almost each issue, as did the German technical periodicals dur-

ing the time when they were still coming. In Canada, likewise, the war is exacting its price. Twenty-four per cent of the membership of the Canadian Society of Civil Engineers (which has 3200 members) has enlisted and 34 of them have been killed. Surprisingly, too, the majority of those who have enlisted are not juniors. The associate members in khaki outnumber the junior enlistment 2 to 1. In a word, the engineers of Canada are true patriots. In the great trial to which the Empire is being subjected, they are willingly bearing their part.

Frozen Concrete Failure

THE FAILURE of the roof of a reinforced-concrete building at Omaha, Neb., reported in the news section this week, again calls attention to the dangers of winter concreting and the results of inadequate protection of materials and finished structures from freezing temperatures. Possibly due to a wider knowledge of the precautions necessary to prevent such failures (see the Engineering Record of Sept. 9, 1916, page 319), there have been relatively few such failures reported during the past winter. The present instance, while not perfectly definite as to the exact details of the causes of failure, gives every evidence that freezing temperature at the time of placing, followed by failure to protect the top surface of the concrete roof, combined with the drying-out effect of the heat from salamanders below the roof, sufficed to prevent setting of the concrete and the development of bond between concrete and steel. The fact that concrete over two and a half months old, if subjected to freezing and thawing during that time and then suddenly thawed out completely, will immediately fall of its own weight is an impressive lesson. The necessity for heat and moisture at least sufficient to allow complete setting of the cement is thus again driven home by the loss of part of a completed structure.

Another Test Discredited

SCIENTISTS are too ready to propose and engineers too eager to accept a new technical definition or specification, especially in these days of the rapid development of the research and control laboratory. Too many half-considered and only partially demonstrated tests are adopted—frequently to find an honored and unquestioned place in “standard” specifications. We have witnessed the advent, the accompanying disturbance and the final disappearance of the autoclave tests, and wonder, occasionally, how many other technical tests are doomed to a similarly unmarked grave. The

latest to receive its *coup de grâce* is the laboratory distillation of tar products, made to estimate the amount of change occurring in these materials on exposure to the action of air and sun. It would be impossible to estimate the amount of excellent material which has been condemned, nor the undoubtedly greater quantity of available tars which have been held as unfit because, forsooth, they have failed to meet the requirements of a test whose artificial nature should have brought it under suspicion from the moment of its proposal. It is unfortunate that, pressed by necessity, we must even tentatively adopt measures of quality before vigorous research has had its opportunity. It is fortunate, however, that we have such organizations as the laboratory of the U. S. Office of Public Roads, which can concern itself with these questions and ultimately render an unassailable decision. The work of C. S. Reeves and B. A. Anderton of the laboratory staff on "The Effect of Exposure on Tar Products," presented before the Franklin Institute, is based on sound experimentation, and its value is hardly to be overestimated. Some day in the not too distant future we may, perhaps, refer such questions in the first instance to adequate investigation.

Where Original Cost Was Found

COMMENT was made by this journal, in its issue of Jan. 27, page 128, on the tentative valuation of the Winston-Salem Southbound Railway, reported by the Interstate Commerce Commission. Attention was drawn to what seemed rather surprising, that, exclusive of land, reproduction cost totaled slightly less than original cost, and that for some items the reproduction figure was barely half that for original cost. There are, however, this journal has since learned, two circumstances which tend to explain the matter.

One is that the reproduction cost estimate does not include every item of original cost. It happens that on this short railroad there are four railroad crossings—some grade, some under. The Winston-Salem Southbound, being the junior road, had to pay the entire cost of all of these crossings. On the basis of use, however, which the Division of Valuation, in estimating reproduction cost, is using for allocating crossings to the railroads involved (where there is a dispute as to ownership) the newer road is allowed only half the cost of grade crossings and none of that of the bridges that carry the older road over the newer. Whether or not this basis of allocation will ultimately prevail—and the carriers opposed it vigorously at the recent hearing in Washington—it was applied to the valuation under discussion, and the four crossings mentioned absorbed no inconsiderable part of the original cost.

The other circumstance is that the Division of Valuation found it impossible to analyze all of the itemized original accounts of the railroad and in some cases found it undesirable as well, in reproduction, to follow the construction methods originally used. For example, expensive rock-crushing machinery at a quarry was charged against ballast in original cost, but against

non-carrier lands and improvements in reproduction cost. The Division of Valuation found it quite impossible to analyze accurately such accounts as ballast and tracklaying to determine just what they did cover, but found that the sum of the ballasting and tracklaying accounts checked the sum of the same accounts in reproduction. Thus considering groups of related items, covering the same elements of physical plant, the Engineering Record is informed that reproduction cost and original cost compare very rationally, the former reflecting the normal trend of prices, but not the abnormal war-time figures.

Filtration, the First Line of Defense

AGAIN the city of Milwaukee has been told that its first line of sanitary defense is a filtration plant. This time it comes with the emphasis of a federal bureau, the U. S. Public Health Service. The facts, stated bluntly, are that the water is continuously polluted and that chlorine, in quantities below the complaint point, cannot kill enough of the germs to make the water safe. A typhoid-fever outbreak is feared this spring. Probably this is the most conspicuous example of a city which cannot make an emergency or factor-of-safety measure fill the place of permanent construction.

In January Dr. A. H. Glennan, acting surgeon-general of the Public Health Service, issued orders to common carriers by lake or rail to discontinue the use of the Milwaukee supply for drinking water for passengers in interstate traffic. This a severe indictment. If the water is not good enough for travelers, is it safe for local consumers? The officials should lose no time in accepting the advice in H. P. Letton's recent report to Mayor D. W. Hoan to hire experts at once to investigate, recommend and put into operation measures so recommended. Mr. Letton, who made the report on conditions for the Public Health Service, recommends that a study and experiments be made to ascertain whether rapid filters can be operated satisfactorily, some question having arisen as to the floc-producing properties of the lake water. In this connection the use of home-made alum, with all the impurities of the bauxite left in, would probably be considered.

With these views on the desirability of filtration John W. Alvord and Allen Hazen both concur in letters to George C. Ruhland, health commissioner. The former reiterates views expressed in the 1911 report of the Alvord-Eddy-Whipple sewerage commission to the effect that the filtration of the water supply ranks first in importance as the cheapest and most efficient health defense work that can be introduced in Milwaukee either now or in the future. Mr. Alvord also makes it plain that filtration of the water supply should be introduced at the earliest possible moment, in addition to the new intake and the proposed sewage treatment works.

The second line of defense is sewage treatment, but filtration is the first, because it deals directly with the

water used by the people for domestic purposes; it is the more delicate and sensitive mechanism for the removal of slight pollution and it is standardized and reliable, 480 plants now serving successfully 40.6 per cent of the urban population of this country. It is apparent that Milwaukee needs both water filtration and sewage plants, and nothing said here is intended to minimize the sewage problem. Both are essential. Both should have been considered simultaneously.

The filter plant for 60,000,000 gal., estimated roughly by Mr. Alvord to cost from \$1,300,000 to \$1,600,000, could be in operation within two years. Will it take a serious typhoid epidemic to bring definite action? The Engineering Record thinks not, for on the committee recommended to the city council by the Mayor to investigate the Public Health Service report are several engineers, including George H. Benzenberg and T. Chalkley Hatton, who know the local situation thoroughly. Dirt should fly by fall.

Caisson Disease and Legislation

WHILE it is undoubtedly to the pecuniary advantage of the "sandhog" to implant in the mind of the general public the idea that the personal risk involved in his calling greatly increases, and that hours of work should be shortened and pay increased for every five or six pounds increase in pressure above 22 lb. to the square inch, it is nevertheless a demonstrated fact that such is not the case. Notwithstanding that the best engineering authorities were aware of the real nature of the risks to men working in compressed air work prior to 1909, the New York State legislature in that year enacted a law embodying provisions for decreasing the working time until a point was reached at 50 lb., where the men spent as much or more time getting into and out of the air chamber as they spent at work. And now Pennsylvania is reported to be considering a similar law.

Contractors in New York State have not seriously protested against this law, because it places all of them on the same footing. Nevertheless the law, which contains several inconsistencies, has increased the cost of compressed-air work in that state, and is now in a fair way to be copied by another important state.

The best authorities on the subject of caisson disease assign as the cause of the disease the liberation of bubbles of nitrogen in the blood and tissues of the body during and after decompression. Since it has been demonstrated that the blood and tissues will dissolve nitrogen at the pressures encountered in compressed air work to 75 or 80 per cent of complete saturation within a short period after entering the working chamber, it is evident that the argument in favor of short working periods, unless these periods could be made actually shorter than 45 minutes, is groundless. It is well understood that, unless poisonous gases are encountered, the chief danger of attack from caisson disease lies in decompression. Therefore it is doubtful whether, except for very high pressures, it does not actually increase

the risk of inducing sickness to decompress the workmen from working to normal pressure twice daily instead of once daily.

Perhaps because the matter is much easier to arrange in tunnel work by reason of the space available in large tunnel bulkheads for additional locks, the New York law prescribes a much slower rate of decompression for tunnel workers than for caisson workers. The only argument in favor of this discrimination against tunnel work is that a caisson starts off at low pressure, the men working in it becoming gradually accustomed to the higher pressures and working under them in any one caisson only a few days. On the other hand, working conditions in caissons are usually considered more severe than in tunnels. It would, therefore, seem that a law which prescribed decompression for tunnel workers at the rate of 1 lb. per minute, while providing for decompression of caisson workers from given working pressures in definite intervals of so many minutes at much more rapid rates, is at least not based on scientific knowledge.

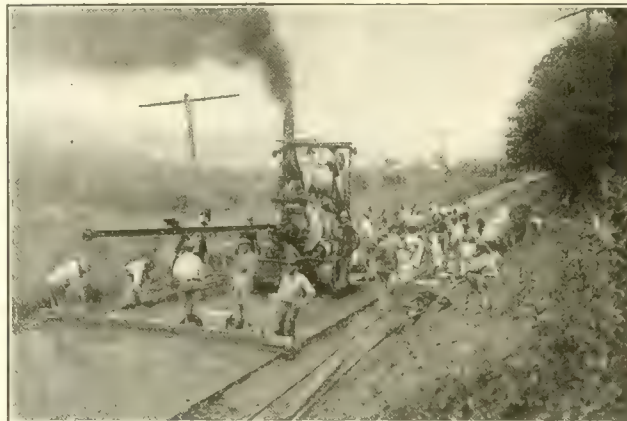
Another feature of this law that is detrimental to the safety of the workmen is that its wording definitely forbids stage decompression. In coming out of compressed air, it has been proved that the practice of reducing the air pressure rapidly to a point 20 lb. or more below the blood pressure will not give rise to the liberation of bubbles in the blood and tissues or to the symptoms of caisson disease. The law should permit stage decompression, known to be the safest method of bringing men out of compressed air, by stating that decompression should take a total time equivalent to a uniform reduction of 1 lb. per minute.

Before the New York law was enacted it was proved on the Pennsylvania tunnels under the East River that no valid argument based on additional safety to workmen can be made for decreasing the daily working period below 8 hours until a pressure of 32 lb. has been reached. Above this pressure, but below 42 lb. per square inch, the "sandhogs" on this contract worked 6 hours out of every 24, while above 42 lb. they worked 4 hours out of every 24. These working periods are much longer than those prescribed in the New York law, but it is a well-known fact that the work was carried out with a rate of sickness and death which is unusually low for such construction in New York City.

While these things are known to engineers familiar with work in compressed air, they are not known to legislators. The Pennsylvania legislature, which, it is understood, has in committee a bill similar to the New York law, should be informed on this subject by engineers before this bill can be enacted into a harmful statute. At least, those engaged in construction requiring the use of compressed air in caissons and tunnels should not sit by and allow the general public to gain the impression that the New York law and the law proposed in Pennsylvania represent the last word in safety practice for compressed-air workers when some of the provisions of these laws are actually more dangerous to workers than accepted engineering practice.



TAR-MACADAM WEARING SURFACE, 1 INCH THICK, WAS PUT DOWN IN TWO APPLICATIONS



CONCRETE PLANT, SHOWING DISTRIBUTION OF MATERIALS AND MEN IN LAYING PAVEMENT BASE

Tar Macadam on Concrete Base Serves Both Motor and Horse Traffic

In Early Work Top Course, $\frac{1}{4}$ Inch Thick, Peeled Off, But 1-Inch Surfacing Later Proved Satisfactory on New York State Highway

By P. H. BRIGHAM

Assistant Engineer, New York State Highway Commission, Binghamton, N. Y.

TO FULFILL the dual objects of carrying a heavy seasonal automobile traffic and of providing a road-bed which would be easy on the hoofs of cattle and horses a tar macadam carpet 1 in. thick on a 5 in. concrete base, 1:2 $\frac{1}{2}$:5 mix, was the type of pavement selected for 7 $\frac{3}{4}$ miles of New York State highway traversing the prosperous farming and summer-resort district in the Susquehanna Valley between Cooperstown and Milford. Roads of the same general type, but with a top course only $\frac{1}{4}$ in. thick, were built a few years ago. They proved failures, however, because the wearing surface was so thin that the calks on horses' shoes pierced it, allowing moisture to penetrate between the base and the top course. The result was that the surfacing either peeled off in large patches or slid, leaving alternate bare spots and bumps. This fault was remedied in the present design by allowing a finished thickness of top course of at least 1 in.

VOLUME OF TRAFFIC

The territory which this road serves contains a large number of dairy farms specializing in pure-bred Holstein-Friesian cattle. Cooperstown itself is a well known summer resort and attracts many automobiles during the summer months. The traffic on holidays and week days throughout the valley amounts to about 1000 automobiles a day, a fair average for the entire season being 500 cars. Horse-drawn vehicles average about 100 a day, carrying milk, hops and other farm produce.

Several of the tar-macadam roads with the $\frac{1}{4}$ -in. wearing course were built in 1912 and 1913.

A similar pavement 14 ft. wide, with a $\frac{3}{4}$ -in. top course and 28 ft. roadway, was built in 1912 between Rockdale and Mount Upton, N. Y., a distance of 2.33 miles. The total construction cost of this highway was

\$13,360 per mile; the cost per square yard of pavement was \$0.942. The subsequent maintenance cost is given in the table.

The maintenance charges on the Rockdale-Mount Upton road for 1916 are not yet available. Although the traffic on this road is not quite as heavy as through the upper Susquehanna Valley, yet the figures probably give a reasonably accurate forecast of the maintenance costs of the Cooperstown highway.

CONSTRUCTION METHODS FOR CONCRETE BASE

Work on the Milford-Cooperstown state highway commenced in April, 1915. Due to the scarcity of commercial crushed stone in the fall of 1915, most of the top course was placed during the early summer of 1916. The road was 7.75 miles long and the pavement width 14 ft., except about $\frac{1}{2}$ mile in the village of Milford, which was 16 ft. wide. The roadway width between ditches was 24 ft. and 26 ft. respectively. Wherever quicksand or springs were encountered, an extra foundation of stone or coarse gravel was used under the pavement, together with 6-in. vitrified tile drains. The tile was placed about 3 ft. below the ditch line and

MAINTENANCE COST, $\frac{3}{4}$ -INCH TAR MACADAM TOP ON CONCRETE BASE, ROCKDALE-MOUNT UPTON ROAD

Year	Item	Total Cost	Cost per Mile
1913	None		
1914	Repairs to surface	\$37.66	
	Patrol	156.00	
	Total, 1914	\$193.66	\$83
1915	Repairs to surface	33.49	
	Patrol	228.00	
	Painting guard railing	\$261.49	\$112
	Cleaning shoulders and ditches	63.10	
		227.56	
	Total 1915	\$552.15	

covered to within 6 in. of the ditch grade with crushed stone, the remainder of the backfill being the most impervious material at hand. After the subgrade was shaped and thoroughly rolled, the sand and stone were distributed in winrows inside the form line and at least $\frac{1}{2}$ mile ahead of the mixing.

Two mixers with boom and bucket attachment were employed, the mixture staying in the drum at least 1 min., with an average of 18 r.p.m. One of the mixers, requiring a fireman and two operators, mixing one-bag batches, began work on June 22, 1915, and in 43 working days laid 20,713 lin. ft. of foundation. The other, needing but one operator, mixing two-bag batches, began work on July 30, 1915, and in 37 working days laid 20,250 lin. ft. of concrete base. The maximum daily output was made by the latter, being 797 lin. ft. of 14-ft. foundation. The total elapsed time for placing the concrete on the entire road was June 22, 1915, to Sept. 20, 1915, inclusive.

FREQUENT CEMENT STORAGE PILES

The cement was hauled on the job as needed from storage piles located at frequent intervals along the road. The water was pumped by two duplex pumps, one to each mixer, through $1\frac{1}{2}$ -in. pipe, which also provided water for sprinkling subgrade and finished concrete. At one place the water was pumped 9000 ft. against a 130-ft. head.

Wooden side forms, 2 x 5 in., were used, being held in place by steel pins. The forms were removed after about 24 hours. The finish of the concrete was obtained by screeding, no troweling or floating being required. The slightly roughened surface thus formed provided a better bond for the top course. Each morning the previous day's work was covered with about 1 in. of earth, which was kept moist for at least seven days, after which it was scraped off and the road opened to traffic.

LABOR

About 30 men were employed at each mixer and were distributed as follows: 1 foreman; 2 or 3 operators and fireman (fireman sprinkled subgrade); 1 pump fireman; 2 handling cement (1 from wagon and 1 to mixer); 3 or 4 setting side forms, removing forms and sprinkling concrete; 2 trimming subgrade; 2 handling template; 3 leveling the concrete with shovels ahead of the template; 9 or 10 shoveling and wheeling stone, and 5 shoveling and wheeling sand.

The top-course specifications called for cleaning the



WHERE SPRINGS AND QUICKSAND WERE ENCOUNTERED TILE DRAINS COVERED WITH STONE WERE LAID

concrete, after which high-carbon binder tar was applied at the rate of $\frac{1}{2}$ gal. per square yard. The tar was heated to about 250 deg. Fahr. in the tank cars in which it was shipped, and applied at from 40 to 50 lb. pressure. The pressure distributor was hauled by a tractor, which also furnished steam to run the air-pressure pump. Immediately after applying the tar, $\frac{3}{4}$ -in. stone was spread, only enough being used to keep the tar from picking up while being rolled. A 10-ton roller was then started, and the rolling and spreading continued together until about 1-in., loose measure, of $\frac{3}{4}$ -in. stone was applied. Enough of this size stone was used so that no tar came to the surface, yet each stone was bedded in tar. A second application of tar, $\frac{1}{2}$ gal. per square yard, was distributed as described, and this was covered at once with a thin layer of screenings. As before, the rolling and spreading of the stone were carried on simultaneously. It required about $\frac{3}{4}$ in., loose measure, of screenings to prevent the pavement from bleeding. In building this top course it was found that the first layer of stone could be rolled too much, forming a thin layer of dust to which it was hard to make the second coating of tar bind, but thorough rolling of the second application improved the pavement. With an average of 5 men sweeping and 15 men spreading stone, the progress was about 1500 lin. ft. of finished wearing course a day.

CRACKS

About $\frac{1}{2}$ mile of top course was laid in the fall of 1915. On this stretch no cracks developed and the entire pavement wintered well. On the remaining concrete foundation transverse cracks showed up during the winter at an average of 50 ft. apart, some of the resulting slabs being over 100 ft. long, while others were only 20 ft. long. No expansion joints were provided during construction, but whenever the work was stopped for any length of time a vertical joint was placed and the concrete brought up to it. A slight change in design might have prevented some of the longitudinal cracks. The plans showed a crowned subgrade which should have been designed flat and thus the crown of the pavement would have made an increased thickness at the center, giving more strength at this weak plane. Before the top course was started all cracks were cleaned out their entire depth and poured flush with hot tar.

Several unusual structures were used in building this road. A special guard rail, having concrete posts



WOOD-CONCRETE GUARD RAIL AND SIX-SIDED GUIDE POST AND DIRECTION SIGNS

and wooden rails, was specified instead of the customary all-wood guard rail. The posts were 7 ft. 3 in. long, 6 x 6 in. in cross-section, reinforced with a $\frac{3}{8}$ -in. deformed steel bar in each corner and were placed 3 ft. 6 in. in the ground. Wooden rails, 2 x 6 in., were bolted through the posts and painted three coats of white paint. At the rail joints 3-16-in. channeled plates, 18 in. long, were provided, to which the ends of the rails were bolted. The contract price for the guard railing, in place complete, was 45 cents per linear foot. The concrete posts, being practically permanent, eliminate the high maintenance expense of replacing wooden posts, which decay rapidly at the ground line.

GUIDE SIGNS

The guide signs were 1-in. pine boards, 3 ft. 4 in. long and 6 in. wide, having black enameled letters 4 in. high on a white background. One end of the sign was pointed to indicate the direction. Distances were given to the nearest $\frac{1}{2}$ mile. These guide signs were fastened to six sided reinforced-concrete posts by means of T-bolts. The six sided posts, superseding the older design which was four-sided, were designed to fit better the different angles met with in intersecting highways. The contract price for the posts was \$10 each and for the signs, in place complete, was \$1 each.

Due to the scarcity of suitable cobbles for paving ditches of over 5 per cent grade, a 1:2:4 concrete gutter, 6 in. thick, was substituted. During construction it was found impracticable to smooth the concrete to the correct section with a template, so that the concrete, after being placed and roughly shaped, was covered with a light coating of mortar and then floated into the proper section. Vertical joints, with tarred paper between, were placed at 6 ft. intervals. To date no slabs are displaced or cracked, although about 1200 sq. yd. was placed during the late summer of 1915. The contract price was \$1.04 per square yard, in place complete, not including the necessary excavation.

MATERIALS TESTED

All stone, sand, cement and tar were sampled before being shipped, and tested and passed on by the highway commission laboratories before being used on the job. In addition, field tests of sand were made covering each day's work. These tests were for per cent passing a No. 20 and a No. 50 sieve. There was also a loam determination. Twice during construction the sand was found to be unsatisfactory. The first time it was too fine and was corrected by mixing some coarse sand into what was delivered on the road; the second time there was an excess of loam, which fault was stopped by notifying the shippers that better washing would be required. For every 500 cu. yd. of concrete foundation placed, two 6-in. cubes were made. After being kept in moist sand for 21 days these cubes were shipped to the laboratories, and at the end of 28 days they were tested on a compression machine. The breaking strength of the 36 cubes on this road averaged 2344 lb. per square inch, which was well above the minimum required.

The total cost of the road, including culverts, excavation, and details, such as guard rails, gutter paving, etc., but exclusive of engineering, was \$89,075.29 or \$11,622.62 per mile. The cost of the pavement was as follows:

	Per Sq. Yd.
1:2½:5 concrete foundation, 5 in. thick.....	\$0.708
Top course, including stone and tar, in place, complete....	.2225
Total cost of pavement.....	\$0.9305

For comparison there are listed below the average costs of several of the common types of pavement built in this section of New York State and compiled from data in the 1915 bulletin of the highway commission:

	Per Sq. Yd.
Waterbound macadam, 15 roads.....	\$0.737
Waterbound macadam with hot or cold oil surfacing, 13 roads.....	.8103
Grouted bituminous macadam, 23 roads.....	.946
Concrete pavement, 27 roads.....	1.117
1:2½:5 concrete foundation with mixed bituminous macadam top course, 7 roads.....	1.335

It is readily seen from the foregoing table that in first cost the tar-macadam top course on a concrete foundation is nearly the same as the grouted bituminous macadam and considerably less than concrete pavement. In regard to these three competing types of medium-priced pavements, the composite type has many distinct advantages. Practically all failures of macadam roads can be traced to poor foundation. The stone of the lower courses sinks into any soft spots in the subgrade and the top course follows. This forms a pot hole which is a source of constant trouble and maintenance expense and makes a rough road for the traveling public. In a pavement with a concrete foundation, the concrete bridges over these weak points in the subgrade, thus eliminating one of the worst features of an all stone pavement.

Concrete pavement, while a type requiring little maintenance, is high in first cost, needs extra care in construction and in the choice of the materials used as ingredients, and is slippery and hard for horse traffic. No expansion joints are needed in the composite type of pavement, as the bituminous macadam mat keeps moisture and temperature conditions constant in the slab, thus protecting it from extreme changes resulting in cracking and displacement. Should the base crack, as it is not exposed to traffic, it requires no maintenance. The only maintenance necessary for this pavement, therefore, is to patch the wearing course as weak spots develop and to clean ditches and culverts. Possibly every three or four years a light oil should be applied to enliven the old bituminous material.

ADVANTAGES OF COMPOSITE PAVEMENT

This leaves the composite type of pavement with the following advantages: Low first cost; low annual maintenance charge; simple to construct; less care in selecting the materials entering into its structure; permanent base on which to build any type of surfacing, should the original wear out, and smooth and resilient surface for automobilists and horsemen.

This highway was constructed under the supervision, plans and specifications of the New York State Highway Commission, of which H. E. Breed is deputy commissioner in charge of construction; H. E. Smith, division engineer, and A. T. Paine, county assistant. The writer was in direct charge of the engineering and inspection. The contractor was the Newport Construction Company of Herkimer, N. Y.

Chicago Will Have 5,000,000 Population in 1950

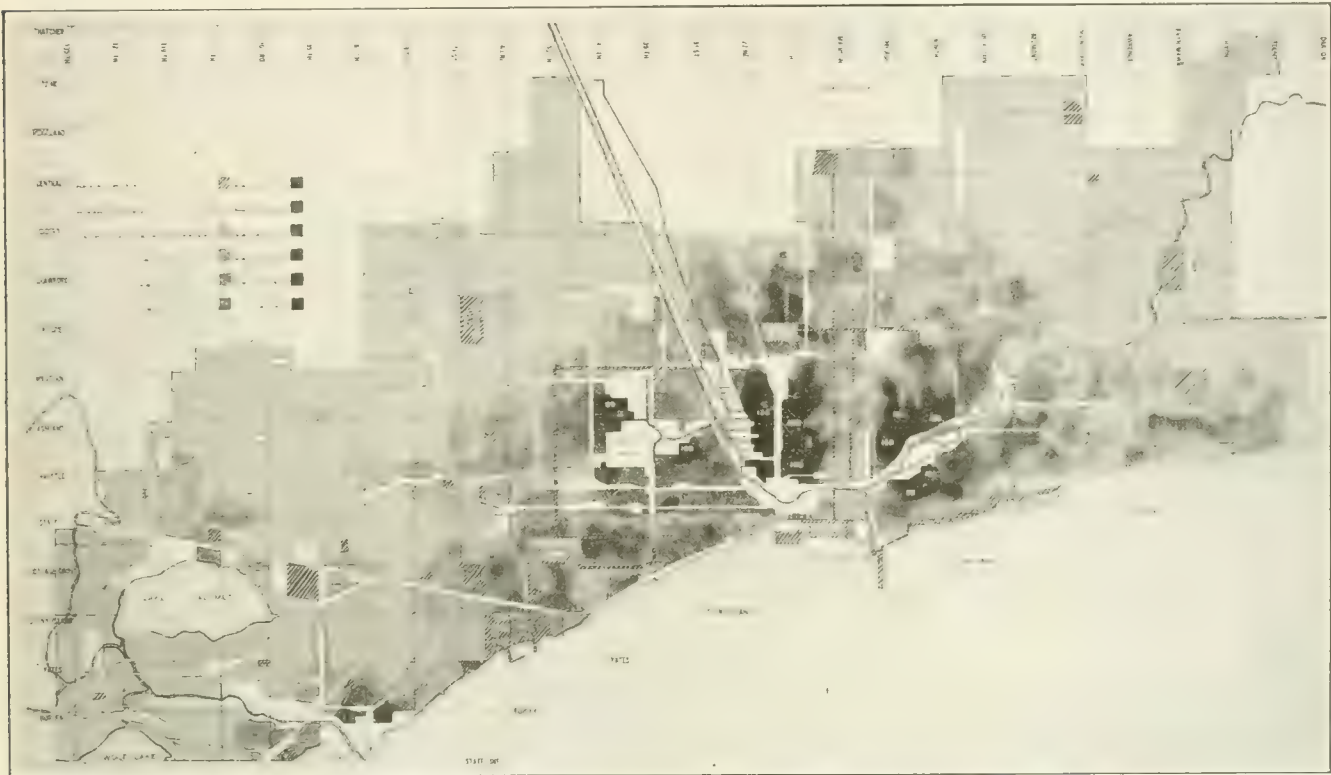
Traction and Subway Commission Makes Estimates of City Growth to Anticipate Transportation Needs and Earning Power

AS THE BASIS for estimating the gross earnings of the proposed consolidated traction system in Chicago in the future, and the number of passengers which the system will be expected to serve, the Chicago Traction and Subway Commission has made an elaborate study of the characteristics, growth and development of the city in so far as they have a direct bearing on its transportation problems. The main report of this study was abstracted in the Engineering Record of Dec. 23, 1916, page 770. The commissioners, William Barclay Parsons, Robert Ridgway and Bion J. Arnold, reached

populated as this one—one located adjacent to the Stock Yards and the other north of the Loop district between Wells Street and Halsted Street and Chicago Avenue and North Avenue.

These heavily populated districts, however, are not so dense as those in some other cities—notably the East Side of New York, which has 410,000 persons per square mile, or 640 per acre, and certain blocks reaching a maximum of more than 1000 per acre. The average number of persons per square mile in Chicago is 12,787, or 20 per acre, while that of Manhattan Island, New York City, is 105,000 per square mile, or 164 per acre—more than eight times as great. A comparison of ten of the largest American cities for the year 1910 indicates that while Chicago is second in population it is only seventh in density.

The rapid spreading out of the population of Chicago, or the low density per unit area, is attributed to the



CONTOUR MAP MARKS ZONES OF DENSITY OF CHICAGO'S POPULATION

a general conclusion that it is reasonably safe to assume that Chicago's growth will continue at a rate which will realize a population of not less than 5,000,000 persons by the year 1950.

DISTRIBUTION OF PRESENT POPULATION

The manner in which the present population of Chicago is distributed over the city area, which has a material bearing on the possibilities of any transportation plan, is illustrated in a density contour map shown herewith. The most densely settled districts are seen to be located between the north and south branches of the Chicago River and Western Avenue. Within this area the population reaches a maximum density of 165,000 persons per square mile (250 per acre) for a few city blocks. About half of the mentioned area shows a density of 100,000 per square mile or over. Only two other small sections of the city are as densely

level nature of the topography of the city and the ease with which sections can be opened up for building purposes, together with certain provisions in the building laws which practically limit the economic height of apartment buildings. The construction of surface and elevated lines, which have constantly reached out into new territory, has also stimulated the outward movement of population. An important fact in this connection is that since 1900 the inlying district bounded by Twenty-second Street, Halsted Street and Chicago Avenue has recorded a decrease in residential population.

The analysis of Chicago's population brings out the fact that the low average density of twenty persons per acre for the whole city area is largely due to the wide distribution of its principal residential districts, lack of uniform building in these districts and the large areas still undeveloped. This separation of the

residential population into many districts and the relatively low average density of the areas tributary to practicable transit routes promise a volume of traffic sufficient to support certain high-speed elevated lines at the present time, but insufficient to support corresponding subways, with their much greater cost, until development has proceeded further.

REVENUE RIDES EXPECTED IN 1950

With the increase in population estimated through the year 1950, the commission attempts to derive from this the number of total revenue rides which may be expected. Any increase in traction gross receipts depends on a growth in population, an increase in rides per capita or both. The riding habit, or number of rides per capita per annum, the report proceeds, varies with the size of cities, but has a general upward tendency with increases of population and increases in city area.

In the financial plan, presented in another part of the commission's report, the number of revenue rides per capita was arbitrarily assumed to increase at the rate of two rides per annum; that is, from 334 in 1917 to 400 in 1950. The latter figure, coupled with the estimated population of 5,000,000 for the same date, warrants the estimate of a passenger revenue of \$100,000,000 and gross receipts of \$104,500,000, which includes such additional income as other revenue from transportation, revenue from other railway operations, non-operating income and profit-and-loss credits.

Brush Used Successfully in Toronto Trickling Filter

Distribution of Sewage Over the Surface Does Not Need to Be Very Uniform—Especially Adapted Where Stone Is Scarce

A TYPE of sewage trickling filter in which brush is the filtering medium has been in use at Toronto, Canada, for more than two years. At the end of two months it was treating sewage at the rate of 6,000,000 imp. gal. per acre per day. According to Lieut.-Col. G. G. Nasmith, director of laboratories, Department of Public Health, Toronto, in an article appearing in the *Journal of the Royal Sanitary Institute* for December, and from which these notes are taken, a very high degree of nitrification has been obtained; the effluent has been uniformly stable, and the installation, it is stated, is a decided success.

After numerous experiments with laths and other material that would provide a freer circulation of air than the usual type of filter, and also increase the amount of surface on which the bacterial slime could accumulate, it was decided to use bundles of brush for the filtering material, in the hope that a greater quantity of sewage could thereby be oxidized in a given time. Accordingly, the stone was removed from an existing trickling filter and replaced by brushwood, which was cut and made into bundles by means of a box press. The bundles were then placed in the filter, care being taken to leave a 1-ft. space between the brush bundles and the wall and also a small space in the center in order to allow air to enter freely from the sides. A revolving distributing sprinkler, which had been used in connection

with the stone filter, was placed in operation, with the result that the brush quickly became matured.

In an article by George Phelps, engineer in charge of North Toronto sewers and disposal works, which appeared in the Feb. 8 number of the *Canadian Engineer*, it is stated that the filter, 50 ft. in diameter, was filled to a depth of 5½ ft., which later settled to a depth of 4½ ft., but that the shrinkage apparently stopped at the end of 18 months. No signs of the rotting out or breaking down of the brushwood are as yet in evidence. The cost of placing the brushwood in the filter, which also includes cutting, bundling and hauling about ½ mile, was \$1.20 per cubic yard. Witchhazel was found to bundle most easily; but nearly every kind of wood is suitable provided it is green and cut at a time when there are no leaves. It is further noted that the sewage passes through a coarse screen, detritus tanks and sedimentation tanks with a 3-hour detention period before reaching the filter, which, it is claimed, now receives 7,250,000 imp. gal. per acre per day, with the probability of an increased rate in the future. The effluent contains 0.1 to 0.2 cu. cm. of sediment per liter, but is a fine humus which is settled by one-half-hour retention in tanks, and indicates a stability of nearly 10 days when tested with methylene blue.

It is hoped, according to Lieutenant-Colonel Nasmith, that the cheapness of the system will enable communities to install systems of sewage disposal in districts where the high cost of the accepted types of installation has been prohibitive. A suggestion is made, as far as the cost of installation is concerned, that the brush filter would solve the problem in the prairie provinces of Canada or similar localities, where stone would in many cases have to be hauled by train for hundreds of miles, with a high resultant cost.

ADVANTAGES OF BRUSH MEDIA

In conclusion, Lieutenant-Colonel Nasmith summarized the advantages of the brush filter as follows: (1) Brush is cheap, and may be obtained almost anywhere; (2) skilled labor is not required in construction; (3) it does not sludge; the slime will frequently become quite thin after heavy rains when the sewage is diluted, though the efficiency of the filter is unimpaired; (4) the brush may at any time be removed and burned; (5) it is durable; a filter has now been in operation for more than two years without showing any signs of decay; (6) the distribution of the sewage over the surface of the filter does not need to be very uniform; the general tendency is to redistribute itself in the filter meshwork; (7) it gives the maximum amount of surface, with a freer circulation of air in a unit volume of space; (8) it has proved to be a success when treating the sedimented sewage of a city on a large scale, and has treated three times as much sewage to the acre as the standard stone filter will treat.

In Locating Military Roads, Remember —

While highways intended primarily for military purposes should be located near our boundaries, they must not be so near that they can be easily raided or captured by small bodies of the enemy and thus likely to be of use only to him and not to us.

Concrete Cantilever Beams Support Island Hotel Entranceway

Flat-Slab Floors Without Column Capitals Facilitate Arrangement of Partitions in Eight-Story Building at Aurora, Ill.

CANTILEVER beams of reinforced concrete, designed to support an outside entranceway leading from a bridge over the Fox River, and flat-slab floors without column capitals, to facilitate the placing of partitions, are two principal features in the recently completed eight-story Island Hotel at Aurora, Ill. Square columns were adopted, and the four-way system of slab reinforcement was used. Above the cantilever entranceway for three panels of its length the mezzanine floor was also extended over the river on columns supported by the cantilever beams, the heaviest of which is here illustrated in detail.

This modern fire-resistive type of hotel was constructed on an island in Fox River next to the site of a new bridge. The building is 70x100 ft. in plan, with its main entrance on the south side and with a second entrance at the northwest corner, where the hotel adjoins the new bridge. This outside entrance, which is indicated by the photographs, cantilevers 10 ft. over the river, and results in saving space within the building lines to such an extent that one more store is now available which would have been eliminated if this scheme had not been adopted.

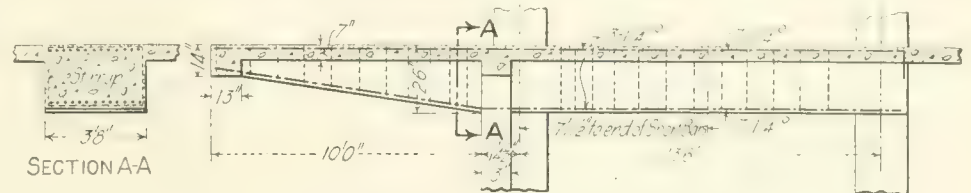
After deciding to adopt the cantilever entranceway it occurred to the designers that a ladies' parlor opening on the mezzanine floor could be located above it as an attractive and economical feature. This two-story part of the cantilever was made three panels long, as illustrated in one of the photographs. The main panel

lengths are relatively short, the square columns in the building being spaced about 14 ft. apart.

The detail drawing of the heaviest cantilever beams, all of which are made continuous over one interior panel to prevent excessive bending in the exterior columns, indicates the heavy reinforcement used in both top and bottom flanges. This steel was required for resisting negative moment over the column when the cantilever was fully loaded.

FLAT-SLAB FLOORS

In order to facilitate the locating and rearranging of partitions, flat-slab floors supported on square columns designed to eliminate the column capitals usually used were adopted. The first-floor slab is 7 in. thick; the slabs used on the upper floors are 6 in. thick. No beams

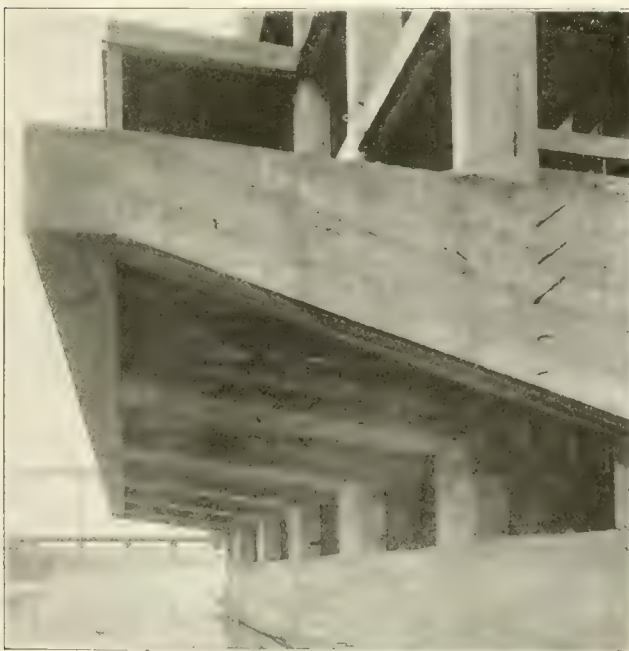


DETAILS OF THE HEAVY CANTILEVER BEAMS SUPPORTING TWO-STORY PART OF STRUCTURE

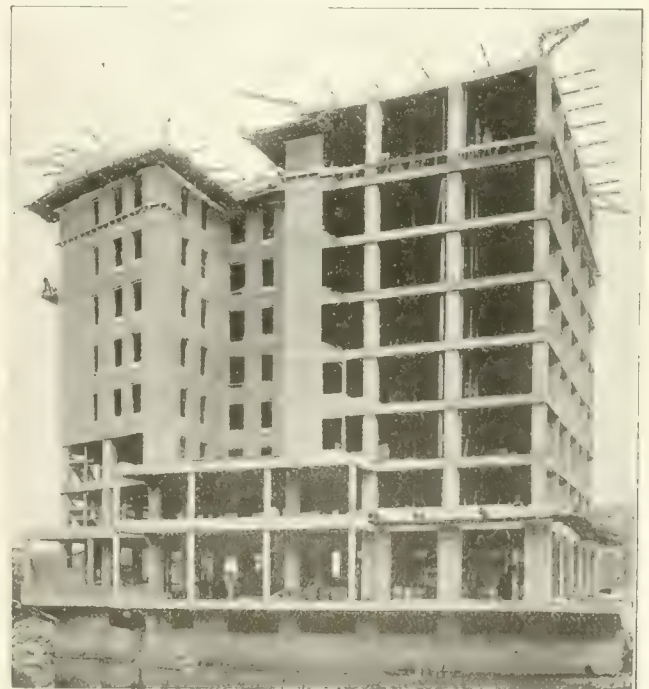
were required except the cantilevers already described and beams for window lintels and to frame around elevator and stair openings. The design of the slabs proved to be economical, four-way reinforcement of $\frac{1}{4}$ -in. rods being used.

The forms for the cantilever beams were also constructed as a cantilever timber framework, owing to the fact that the river bottom beneath the outer ends of these cantilevers consists of boulders, dirt and rubbish, making it impossible to drive piling on the shore.

The structural design was made by the Concrete Steel Products Company, of Chicago. H. Z. Dietz, of St. Louis, was the architect. The contractor was the Caldwell-Marshall Company, of Aurora.



CANTILEVER BEAMS SUPPORT ENTRANCEWAY AND PARLOR



NORTHWEST CORNER OF ISLAND HOTEL DURING CONSTRUCTION

How Davenport Proportions Paving-Assessment Benefits

Method Devised to Eliminate Unfairness of the Front-Foot Rule as a Basis for Computing Taxes

By ROSCOE E. SAWISTOWSKY
City Engineer, Davenport, Iowa

ALL paving assessments in Davenport, Iowa, previous to January, 1915, were made in accordance with the front-foot rule, the code reading as follows: "The cost of making or reconstructing any street improvement . . . shall be assessed as a special tax against the property abutting thereon in proportion to the number of linear front feet of each parcel so abutting."

Except in cases where the assessment exceeds 25 per cent of the actual value of the lot as shown on the assessment roll, the courts have upheld the "front-foot rule" in proportioning the benefits among the several lots, regardless of the fact that the lots might vary from 1 ft. to 300 ft. in depth. The code reads: "Such assessments shall not exceed 25 per centum of the actual value of the lot or tract at the time of levy, and the last preceding assessment roll shall be taken as prima-facie evidence of such value."

In spreading the assessment on the lots abutting on the street being improved, the benefits were determined as being proportional to the frontage on such improvement, disregarding whether or not the assessment exceeded one-quarter of the actual value of the lot or tract. The property owners considering themselves overassessed had the privilege of objecting and filing a petition with the City Council asking that their assessment be reduced. Before the petition is acted upon the first installment must be paid by the objector; then if the council decides that the property has been assessed in excess of 25 per cent of the actual value thereof, it rebates, by resolution, from the improvement fund the amount that the property was overassessed.

NON-ABUTTING LOTS ASSESSED

The state legislature passed a law regarding special assessments for street improvements to become effective Jan. 1, 1914, under which we are now working, and which states, in substance, that the amount to be assessed against private property, on the basis of area, shall "include one-half of the privately owned property between the street improved and the next street, whether such privately owned property abut upon said street or not, but in no case shall privately owned property situated more than 300 ft. from the street so improved be so assessed."

"In case of improvement upon an alley, such assessment shall be confined according to area to privately owned property within the block or blocks improved, and if not platted into blocks, for not more than 150 ft. from such improved alley."

The intent of the code is enigmatical and does not give any suggestion as to how the benefits are to be arrived at. From reading, one would judge that the area assessable should all be assessed at a uniform rate per square foot. The state senator who introduced the bill stated that the intention was to lessen the assessment

on corner lots; that they should not stand the total cost of paving on both sides as under the old front-foot rule, but that properties back to the center of the block should help pay toward the cost of the improvement, as they were benefited to a degree by having the street paved, although they do not abut directly on such improvement.

HOW NEW METHOD WORKS

Fig. 1, "Plat of Street Improvement," shows this method of assessing for street paving. The property to be assessed in each block is shown by the dotted lines and includes one-half the privately owned property.

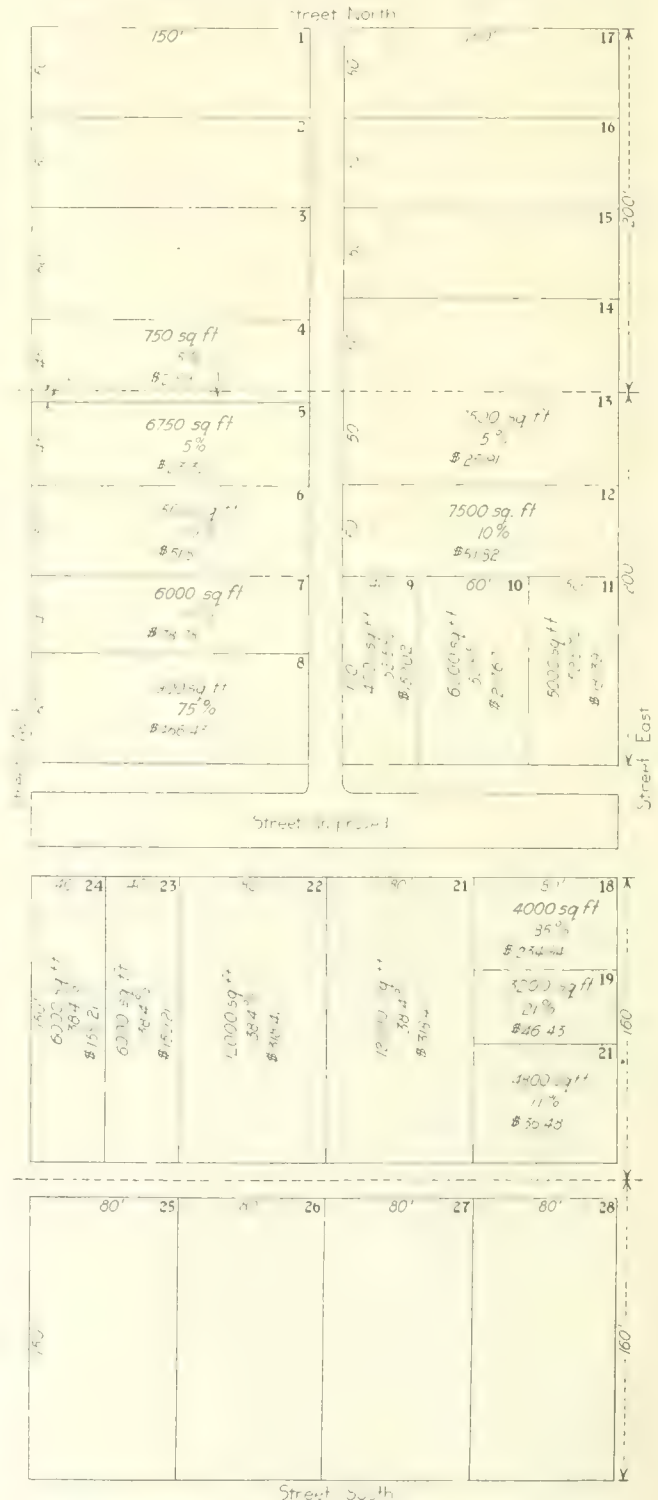


FIG. 1.—PLAT OF STREET IMPROVEMENT, INDICATING METHOD OF ASSESSING FOR STREET PAVING

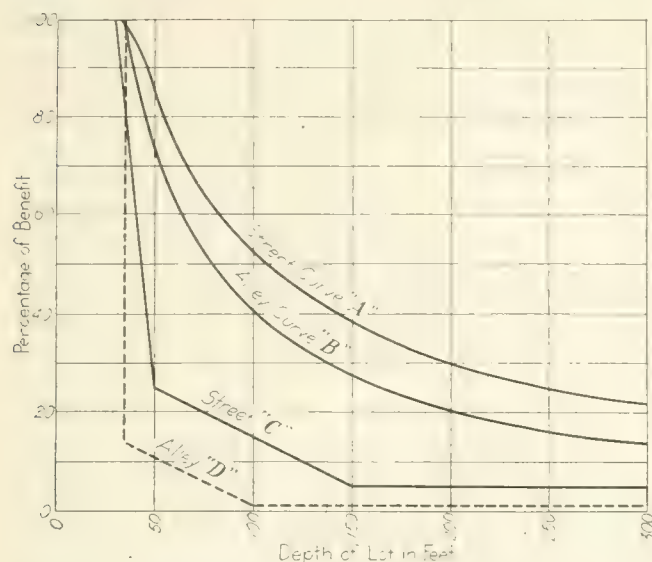


FIG. 2—CHART FOR GRADUATING BENEFITS FOR LOTS OF DIFFERENT DEPTHS, ABUTTING AND NOT ABUTTING ON STREET BEING PAVED



FIG. 3—PLAT OF ALLEY IMPROVEMENT

Granted that the property not abutting directly on the street improved is not benefited nearly as much as a lot fronting on the improvement, it remained to adopt a fair and equitable method of grading or proportioning the benefits that would meet with general approval.

We designed a chart, or curve, Fig. 2, for graduating the benefits for lots of different depths abutting and not abutting on the street being paved, no matter which way they are cut up. The area for the first 30-ft. zone pays at the rate of 100 per cent of its area; the next 20 ft., 62½ per cent; the next 20 ft., 23 per cent; the next 20 ft., 19 per cent; the next 20 ft., 15 per cent; the next 20 ft., 11 per cent; the next 20 ft., 7 per cent; and the next 150 ft., 5 per cent.

To find the rate for a lot abutting on the street improved, obtain the rate directly from Curve A, Fig. 2. Example—Lot 18 (see Fig. 1, plat of street improvement), which has a depth of 50 ft., pays at the rate of 85 per cent of its area. Lot 9, with a depth of 100 ft., pays at the rate of 52.5 per cent of its area. Lot 24,

with a depth of 150 ft., pays at the rate of 38.4 per cent of its area.

For a lot not abutting directly on the street improved read on Curve C, Fig. 2. Example—Lot 7: The south and north lines of Lot 7 are removed 60 and 100 ft. respectively from street improved. On Curve C the rate for 60 ft. is 23 per cent and for 100 ft. 15 per cent. The area of Lot 7 pays at the rate of 19 per cent, or the average between 23 and 15 per cent.

Lot 6 pays at the rate of 10 per cent of its area, and all the area in the zone between lines 150 and 300 ft. distant from the line of the street improved pays at the rate of 5 per cent.

After determining all the lot rates the "rate product" is obtained by multiplying the area by the rate. The total cost of paving the street is then divided by the total rate products to obtain the cost per unit rate product. The accompanying table gives the assessment:

AMOUNT OF ASSESSMENT FOR DIFFERENT LOTS

Lot No.	Area of lot	Rate, per cent	Rate product	Assessment
1	7,600	3.1	237.60	\$23.76
2	12,000	47	5,640.00	\$564.00
3	12,000	27	3,240.00	\$324.00
4	12,000	27	3,240.00	\$324.00
5	12,000	27	3,240.00	\$324.00
6	12,000	27	3,240.00	\$324.00
7	12,000	27	3,240.00	\$324.00
8	12,000	27	3,240.00	\$324.00
9	12,000	27	3,240.00	\$324.00
10	12,000	27	3,240.00	\$324.00
11	12,000	27	3,240.00	\$324.00
12	12,000	27	3,240.00	\$324.00
13	12,000	27	3,240.00	\$324.00
14	12,000	27	3,240.00	\$324.00
15	12,000	27	3,240.00	\$324.00
16	12,000	27	3,240.00	\$324.00
17	12,000	27	3,240.00	\$324.00
18	12,000	27	3,240.00	\$324.00
19	12,000	27	3,240.00	\$324.00
20	12,000	27	3,240.00	\$324.00
21	12,000	27	3,240.00	\$324.00
22	12,000	27	3,240.00	\$324.00
23	12,000	27	3,240.00	\$324.00
24	12,000	27	3,240.00	\$324.00

Practically the same method is used to determine the benefits on alley paving, except that the percentage of benefits drops off more sharply the farther the area is removed from the improvement.

The area in the first 35-ft. zone abutting on the improvement pays at the rate of 100 per cent; the next 35-ft. zone at the rate of 10.5 per cent; the next 30-ft. zone at the rate of 4 per cent, and the remaining 200 ft. at the rate of 1 per cent.

To obtain the rate for Lot 11 (see Fig. 3, plat of alley improvement) the percentage of benefits on alley Curve B (Fig. 2) for 150 ft. is 27 per cent. For a lot not abutting obtain the per cent from Curve D. For example, Lot 7 would be 7 per cent, the average between 11 and 3 per cent, the rates respectively for the distances that the west and east lines of Lot 7 are removed from the alley improved.

Motor-Truck Legislation and Maintenance Essential for Gravel Roads

Iowa has experimented with gravel roads for the last few years. If there is any one lesson of more importance than another to be drawn from the experimental road work during the 1916 season, according to the *Service Bulletin* of the Highway Department, it is that a consistent patrol maintenance is absolutely essential for the upkeep of a gravel road surface. This is true whether the gravel surface is oiled or unoled. A second lesson to be drawn is that if Iowa is to have surfaced roadways of any type now in common use, it will be absolutely necessary to have some regulation as to the use of these surfaced roadways by heavy trucks and tractors with cleats on their wheels.

Operate Continuous-Flow Activated-Sludge Plant

Prof. Edward Bartow Gives the Results of Experiments Utilizing a Former Septic Tank at Champaign, Ill.

IF THE SLUDGE can be dewatered economically the activated-sludge process can be operated successfully, is the conclusion pointed out by experiments on a converted municipal septic tank at Champaign, Ill. The results of these experiments were given recently before the Western Society of Engineers in a paper by Prof. Edward Bartow, F. W. Mohlman and J. F. Schnellbach.

The septic tank designed by Prof. A. N. Talbot in 1897 for the city of Champaign was reconstructed early in 1916 with the expectation that 200,000 gal. of domestic sewage could be treated daily. The plant contains a screen chamber and pumping pit, grit chamber, aërating chamber, settling chamber, blower room, and laboratory containing the sludge-drying apparatus. A sludge-drying bed and a pond into which the effluent from the process may be discharged are also provided.

DETAILS OF PLANT

The sewage is drawn from the main outlet sewer of the city of Champaign. The daily flow is estimated to be from 1,000,000 to 1,500,000 gal. of sewage, though in wet weather, owing to seepage into the sewers, the amount of flow is greatly increased. A screen with vertical bars spaced with $\frac{3}{4}$ -in. openings prevents coarse material from reaching the pumps. The grit chamber is 34 ft. long, and has two compartments, each 1 ft. wide. The sewage flows from the grit chamber into the aëration chamber, a rectangular concrete tank 17x36 $\frac{1}{2}$ ft. in plan and 9 $\frac{1}{2}$ ft. deep, having a capacity, after allowances are made for baffle walls and sloping bottom, of about 36,000 gal. The chamber is divided longitudinally by three baffles into four compartments, through which the sewage flows a distance of about 140 ft. The lower part of each compartment has sides sloping toward the center to a channel 12 $\frac{1}{2}$ in. wide and 4 in. deep and extending the length of the compartment.

Above this channel filtros plates are supported on T-bars embedded in the concrete. The channel below the filtros plates was divided into sections for six filtros plates each, with the expectation that each set of plates would be separated from all the others and that the supply of air to each set could be regulated by an air pipe and valve. Owing to the porosity of the sloping concrete sides, it was impossible to regulate independently each set of plates.

The aëration tank was calculated to be able to treat 144,000 gal. of sewage and sludge daily if aërated during a period of 6 hours, 170,000 gal. if aërated 5 hours, and 216,000 gal. if aërated 4 hours.

SETTLING CHAMBER

The settling chamber is 6x10 $\frac{1}{2}$ ft. in plan and 11 ft. at its lowest point, having a capacity of 3700 gal. If the flow passed through all the tank it would have a retention period of 24, 31 and 37 minutes, with a

flow through the aëration chamber of 4, 5 and 6 hours respectively. In order to assist the settling of the sludge the liquid is passed down into the center and up around the edge of a hollow frustrum of a pyramid in the center of the settling basin. The frustrum of the pyramid is 15 in. square at the top, and 3 ft. square at the bottom, and it extends to within 5 ft. of the bottom of the chamber. From the settling tank the effluent flows over a weir and is either returned to the sewer or discharged into a pond formed by two dams thrown across the abandoned bed of a stream. It covers about 0.1 acre and its maximum depth is 3 ft.

The sludge is withdrawn from the settling chamber by an air lift and can be discharged into the raw sewage, where it enters the aëration chamber, or diverted for experimental purposes, or discharged into the sewer. Air is supplied for aëration and for the air lift by a rotary positive-pressure blower having a rated capacity of 300 cu. ft. per minute, driven by a 15-hp. electric motor. The air is passed through cheesecloth, spread over a box having sides of wire netting, before it enters the blower suction pipe. The air is measured through a Venturi meter.

CAREFUL CONCRETE WORK ESSENTIAL

The plant was put in operation May 25, 1916; but since there was an escape of air along the sides of the baffle walls the plant was operated only until June 11, when it was shut down for repairs. The holes resulted from faulty concrete work and from the difficulty in making a tight joint between old and new cement. The holes were satisfactorily filled. This difficulty should, Professor Bartow pointed out, emphasize the fact that very careful concrete work is essential if the plates are to be set above concrete. Cast-iron or metal frames as used at Milwaukee and Cleveland may be found preferable.

Modifications in the manner of operation were made at intervals in an attempt to determine the method of obtaining the highest efficiency. The time of operation was therefore divided into periods, and average results were determined for each period shown in the table.

Operation was most successful during the periods of Sept. 19 to 22 and Oct. 14 to 22, in which 2 cu. ft. of air per gallon of sewage was used to obtain stable effluents. This amount is higher than the amount required in the experiments in the fill-and-draw tanks. It is probable that some air escaped from the concrete

RESULTS OF OPERATION AND CONTROL OF CHAMPAIGN ACTIVATED-SLUDGE PLANT

Date, inclusive 1916	Rate of flow, gal. per day	Per cent sludge settling, cu. ft. per gal.	Per cent sludge settling, cu. ft. per gal.	Per cent sludge settling, cu. ft. per gal.	Decolorization, methylene blue, hours	Relative stability of effluent
July 11-29	110,500	22.2	12	67	20	33
July 30-Aug. 15	81,700	22.7	15	67	50	64
Aug. 16-Sept. 5	61,100	21.9	24	51	90	90
Sept. 6-12	69,100	21.1	23	48	38	55
Sept. 13-18	82,200	21.3	22	45	105	96
Sept. 19-22	130,000	21.0	16	31	100	95
Sept. 23-28	177,600	1.6	13	26	35	52
Sept. 29	92,700	3.1	18	47	42	62
Sept. 30-Oct. 13	143,200	2.0	19	38	41	59
Oct. 14-22	152,300	2.0	23	48	60	74

Plant shut down Sept. 29 from 10 a.m. to 7 p.m.

channels without passing through the sewage, and for this reason better efficiency might be obtained with a more satisfactory installation for air distribution. The settling tank was too small and the insufficient slope of the bottom (45 deg.) caused some sludge to be retained.

MAKE RETENTION-PERIOD TESTS

The actual period of flow through the settling tank was considerably shorter than the theoretical period. To find the actual retention period 5 lb. of salt and 20 grams of fluorescein in solution were added at the top of the frustum of a pyramid in the settling chamber. The fluorescein was detected in the effluent in 10 minutes. The salt was at its maximum in the effluent in 15 minutes, and the quantity began to decrease in 20 minutes. The rate of pumping on the day of the test was 133,900 gal. The capacity of the settling basin would give a theoretical retention period of 34 minutes, and the actual retention period was found to be less than 20 minutes. The error in calculating the necessary retention period was due to calculations made from the fill-and-draw tanks, where satisfactory settling was obtained after 30 minutes of rest. In vertical-flow settling tanks the velocity of flow must be less than 8 ft. per hour, in order not to carry the sludge away. The possibility of settling the sludge in a second tank before it is pumped back to the sewage might prove practicable.

TRY NEW PRESS

Since drying on sand beds and centrifuging were being carefully tried at Cleveland, while the Berri-gan press, made by the Worthington Company, and the press of the Simplex Ejector Company were being tried at Milwaukee, it was planned to use another method at Champaign. Through the courtesy of the Koering Cyaniding Process Company of Detroit a rotary press was furnished, such as has been used satisfactorily in filtering slimes in extracting gold and silver by the cyaniding process. This apparatus consists of a cylinder of filtros plates supported on a perforated steel cylinder outside of which, at a distance of about 1 in., is a solid-steel outer shell. The material to be filtered is forced into the interior of the cylinder of filtros plates. The cylinder is revolved and a cake of sludge built up on the inside of the filtros plates. The liquid filters through the plates into the space between the inner and the outer shell and is drawn off through outlets in the outer shell. Air pressure can be exerted from the interior to dry the cake and from the exterior to loosen it. The plates can be cleaned by back-flushing with water.

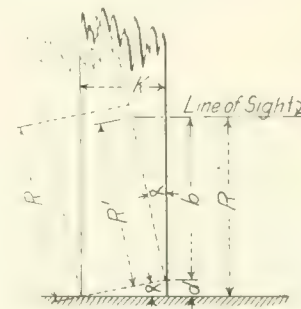
This company has also installed an apparatus for concentrating the sludge before its application to the rotary press. This concentrator consists of a cast-iron box 2 ft. square and 4½ ft. deep, inside measurements, lined with filtros plates. On the outside of the filtros plates are four independent compartments, through which the filtrate may be withdrawn or into which air or water may be forced for cleaning the plates. It is expected that the liquid sludge may be considerably concentrated in this apparatus so that the capacity of the rotary press may be greatly increased.

Swaying of Level Rod Causes Errors in Readings

Figures Given to Show Why Common Practice Adopted for Accuracy Should Be Prohibited

By S. GROMAN
Brooklyn, N. Y.

DISCUSSION frequently arises among engineers as to the advisability of swaying the rod in accurate leveling. It is to form an accurate means on which to base a decision on this matter that the following analysis is undertaken. When the rod is held on a flat surface in a vertical position, the true reading is obtained. If it is tilted forward the reading on the rod increases. When tilted backward, however, the reading obtained is not always greater than the true reading, due to the fact that the rod is rotating about the back or heel of the rod instead of a point in the same plane with the face of the rod, as shown in the drawing. R is the true rod reading when the rod is held plum; R' , the rod reading when inclined backward at an angle α with the horizontal. K is the distance from face of rod to heel of rod.



WHAT HAPPENS WHEN LEVEL ROD IS SWAYED

ERRORS ANALYZED

To get the error produced by tilting the rod we must obtain the minimum value of R' , for it is the usual practice when swaying the rod to take the smallest reading. This would be true if the rod were a plane surface. From the figure it can be seen that $d = K \sin \alpha$, and $b = R - d = (R' \cos \alpha)$. $R' = (R - d) / \cos \alpha = (R - K \sin \alpha) / \cos \alpha$.

To obtain the minimum value of R' we take the derivative of R' with respect to α , which derivative when placed equal to zero will give us the angle at which R' is a minimum.

$$\frac{dR'}{d\alpha} = \frac{[\cos \alpha (-K \cos \alpha)] - [(R - K \sin \alpha) (-\sin \alpha)]}{\cos^2 \alpha} = 0$$

$$\text{or } [\cos \alpha (-K \cos \alpha)] + [(R - K \sin \alpha) \sin \alpha] = 0$$

$$\text{or } -K \cos^2 \alpha + R \sin \alpha - K \sin^2 \alpha = 0$$

$$\text{or } -K(\sin^2 \alpha + \cos^2 \alpha) + R \sin \alpha = 0$$

$$\text{or } -K + R \sin \alpha = 0$$

$$\text{or } \sin \alpha = K/R$$

Therefore the sine of the angle at which R' is a minimum is K/R . Substituting this value of sine α in the general formula for R' we will have the minimum value of R' for any true rod reading R in terms of K and R . Calling this R'_m ,

$$R'_m = \frac{R - K \sin \alpha}{\cos \alpha} = \frac{R - K \frac{K}{R}}{\sqrt{1 - \frac{K^2}{R^2}}} = \frac{R - \frac{K^2}{R}}{\sqrt{1 - \frac{K^2}{R^2}}} = \frac{R^2 - K^2}{R \sqrt{1 - \frac{K^2}{R^2}}}$$

$$\text{or } R'_m = \sqrt{\frac{R^2 - K^2}{1 - \frac{K^2}{R^2}}} = \sqrt{\frac{R^2 - K^2}{\frac{R^2 - K^2}{R^2}}} = R$$

Having the formula $R'_m = R - K$, we are now able to find the error produced by backward tilting of the rod since the error is $(R - R'_m) = E$. The usual thickness of a Philadelphia rod at the shoe is about $1\frac{1}{2}$ in. = 0.125 ft. Since the face of the rod is set in about 0.01 ft., the effective thickness of the rod, $K = 0.115$ ft. With this value for K the value of $(R - R'_m)$ for different readings is as shown below:

R in feet	E in feet	R in feet	E in feet
0.5000	0.0134	5.0000	0.0013
1.0000	0.0066	6.0000	0.0011
2.0000	0.0033	7.0000	0.0009
3.0000	0.0022	8.0000	0.0008
4.0000	0.0017		

SWAYING SHOULD BE PROHIBITED

As can be seen from the foregoing results, the error produced in a small-rod reading is so great as to make it absolute folly to sway the rod on a flat surface. Even when the rod is held on a point there is an error produced in swaying the rod, the effective distance K now becoming one-half its former value. This for all practical purposes cuts the error in half, but it still is large for readings up to 3 ft. Furthermore, it is an error which may be eliminated, and in accurate leveling the swaying of the rod should be prohibited. It may be stated that the elevations will not be affected by the same amount as the rod readings, for if the reading is too low on both foresight and backsight the error will be partly compensated. Indeed if the rod read the same on foresight as on backsight there would be no error introduced in the final elevation. However, such a condition does not exist in practice. If a bubble is attached to the rod the rod will be held plumb and leveling can be done quickly and accurately.

Oregon to Vote on \$6,000,000 Road Bonds

Legislation Also Passed Simplifying Existing Road Laws, Creating State Highway Engineer and Regulating Motor Vehicles

THE OREGON LEGISLATURE which has just adjourned has provided for submission to the voters, at a special election to be held June 4, 1917, a \$6,000,000 bond issue to be used in constructing a system of state highways. It is proposed to meet the interest and refund the principal by doubling the motor-vehicle tax. In addition, the legislature has provided for the issuance of \$1,900,000 of road bonds in the event that revenues from established sources are not sufficient to match the federal-aid appropriations. Administration of the funds and construction of the highways will be under the supervision of the state highway commission and the state highway engineer.

NEW CODE ANNULS OBSOLETE PROVISIONS

A notable improvement in the new road laws of the state has been the annulment of many obsolete and conflicting provisions by the adoption of a new code, one section of which provides standard methods for opening, laying out and vacating highways. Heretofore three different processes have been available, which promoted more uncertainty and confusion than good

highways. Another section regulates the expenditures of county funds and the administration of county work, doing away with the present supervisor system and providing for the appointment of a county roadmaster. This will effect a centralization of authority and will eliminate the haphazard and expensive system previously in force.

OFFICE OF HIGHWAY ENGINEER CREATED

Still another measure is known as the "State Highway Code," which provides a procedure for the construction of hard-surfaced highways and for the co-operation of county and State in construction of state highways. It provides also for the appointment by the governor of a non-salaried highway commission of three, which appoints the highway engineer, at a salary of \$5,000 a year.

A measure to regulate motor vehicles was also passed at this session. The present motor-vehicle-license tax is doubled, and the entire proceeds are to be devoted to road work under the supervision of the state highway commission. The old law required that motor-vehicle-license fees be apportioned to the counties in which they were collected, after paying for license tags and other incidentals of state administration. The money was thus scattered, and inefficiently expended in many instances. On the basis of the existing number of vehicles in Oregon about \$300,000 a year will be paid into the state-road fund from this source.

The foregoing information was obtained from Roy A. Klein, highway engineer, Portland, Ore.

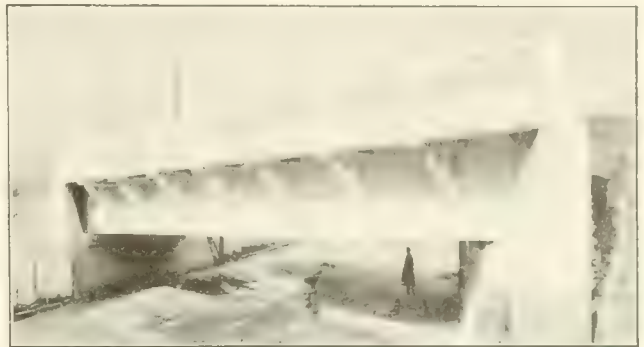
Rules for the Harvesting of Ice

That no epidemics in communicable diseases caused by pollution in ice have been discovered in Minnesota is the conclusion drawn from investigations undertaken by the Minnesota State Board of Health, as stated by H. A. Whittaker, director of the division of sanitation, in an article in the February number of *Minnesota Municipalities*. The investigations have shown that the danger from ice lies more in the way it is handled during its distribution to the consumer, and by the consumer, than in the ice itself, provided certain rules are observed in harvesting the supply. The bacteriological results, besides showing the purification of water which takes place on freezing, indicate the need of thoroughly removing soft, cloudy ice from the surface of the cake before the ice is stored or distributed to the public. All of which leads the Minnesota State Board of Health to make the following rules governing the harvesting of ice: (1) Bodies of water as free as possible from pollution should be selected for the ice field. (2) The water under the ice at the time of harvesting should be at least 3 ft. deep and free from suspended material of every description. (3) Ice fields should not be selected at locations where the surface of the ice may be flooded with polluted material which will subsequently become frozen and form a portion of the cake. (4) The ice should be clear and free from visible foreign material. (5) Before storing, the surface of the ice should be scraped free from snow, soft ice and foreign material. (6) Special care should be taken during the cutting to exclude any ice polluted by human or animal excreta.

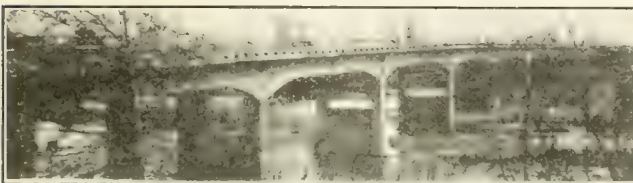
California's Bridges as Good as Her Highways



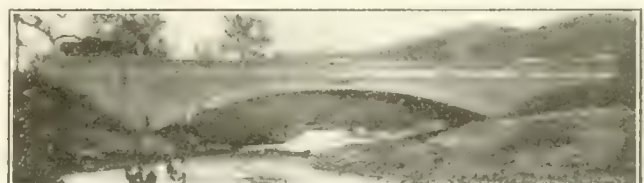
LOS ANGELES COUNTY BUILDS FOR 35-TON TRUCKS OVER
SAN GABRIEL RIVER



CEMENT STUCCO DECK GIRDERS OVER VERDUGA WASH,
NEAR LOS ANGELES



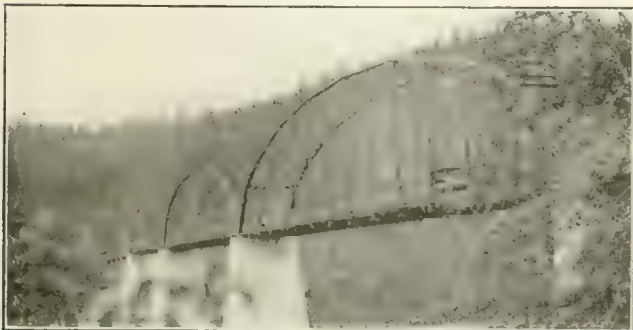
CONTINUOUS-GIRDER DESIGN BY GIVAN AND PEARCE—BEAR
RIVER, PLACER COUNTY



EIGHTY-FOOT REINFORCED CONCRETE ARCH, ATASCADERO CREEK,
SAN LUIS OBISPO COUNTY



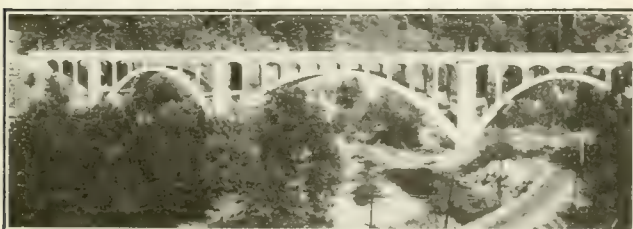
THE CITY OF REDDING IS MADE ACCESSIBLE BY FIVE 115-FOOT SPANS OVER THE SACRAMENTO RIVER—DESIGNED BY A. V. SAPH



DIFFICULT TOPOGRAPHY RESPONSIBLE FOR LONG, HIGH SPANS
OVER EEL RIVER



ARCH WITH "MUSHROOM" FLOOR DESIGNED BY C. A. P. TURNER,
ELDORADO COUNTY



AT DUNSMUIR THE SACRAMENTO RIVER LIES 70 FEET BELOW
THE BRIDGE FLOOR



PERMANENT ESTHETICS FOR SANTA BARBARA COUNTY—
EDWARD T. FLAHERTY, DESIGNER

Test Procedure for Obtaining Weight per Cubic Foot of Sand

Size and Shape of Measure, Method of Filling and Amount of Moisture Varied—Wet Sand Shows Wide Variations—Dry Sand Necessary

EXPERIMENTS for the purpose of ascertaining the method and apparatus by which the most reliable results in the determination of the weight per cubic foot of sand by different operators under different conditions may be obtained were reported by Sanford E. Thompson, chairman of the committee on aggregates, at the last annual meeting of the American Concrete Institute. This work was done under the auspices of a joint committee of the American Society for Testing Materials and the American Concrete Institute, under the direction and supervision of a subcommittee on weight, voids and specific gravity, of which Cloyd M. Chapman is chairman.

The conclusions reached as the result of these tests are here reproduced.

CONCLUSIONS BASED ON DRY SAND

Remembering that the variables which need to be standardized are (1) the size and shape of the measure, (2) the method of filling the measure, and (3) the amount of moisture in the sand, experiments were made at seven different laboratories on sand of two grades—one coarse, the other fine. With wet sand a much greater range in average weight, average maximum variation and mean variation was obtained. Because of this great range, the conclusions presented in the discussion are based wholly on the results for dry sand.

Seven different methods of filling the measures were tried, namely: A, filled and struck; B, filled and jarred; C, jarred while filling; D, tamped in layers; E, filled and tamped; F, filled through funnel; G, inner tube, and a cone method used in one laboratory only. The lower weights were obtained by methods A, F and G, while the higher weights resulted from methods C, D, and the cone. The cone method showed least total variation, with methods D and G as second choice, while for mean variation the cone method was lowest, with methods F and D as second and third.

SIZE OF MEASURE OF LITTLE IMPORTANCE

The results for size and shape of measure show slightly higher values for larger cylindrical measures than smaller ones, while the cubical measures of $\frac{1}{4}$ cu. ft. capacity gave a somewhat lower result, probably due to failure of the sand to pack as closely in the corners. The differences are small, however, and may not influence the choice of size, except to show that one size and shape should be adopted as standard. The cone measure, due chiefly to the method of compacting and filling, gives very much higher weights, so high, in fact, as to bear little relation to the weight per cubic foot of sand in any condition which would be found in practice. The mean variation shows that, size for size, the round measures are more concordant than the square measures.

Before a definite choice can be made of both method and container it will be desirable to conduct further investigations to ascertain the degree of compactness

of sand in the various conditions in which it exists on the job and in concrete and mortar. Such investigations are in progress, and a choice of method and measure will be recommended for adoption when more complete data are gathered.

Scituate Reservoir Will Be Cleared, But Not Stripped

Annual Report of Providence Water Supply Board Describes Treatment of Storage Basin

IN the annual report of the Water Supply Board of Providence, R. I., dated Jan. 1, 1917, it is announced that the area to be flooded by the proposed Scituate reservoir will be cleared, but not stripped. The new basin will have a capacity of nearly 37,000,000,000 gal. and a water surface of 3400 acres, with an average depth of 33 ft. On the subject of stripping the report contains the following:

"By reservoir stripping is meant the removal of surface loam to a depth usually of about 1 ft. There are very few reservoirs used for water supply or other purposes which have been stripped, nearly all of which are in Massachusetts, the largest being the Wachusett Reservoir with an area of about 4100 acres, and the next largest being the Sudbury Reservoir with an area of about 1300 acres. The other stripped reservoirs are of very small size. The entire supply for the city of New York, outside of the ground waters used on Long Island, is from unstripped reservoirs, the same being true of practically all supplies from reservoirs except those of a few cities and towns in New England. It was decided not to strip the Scituate reservoir but to substitute therefore thorough clearing. Such clearing consists of cutting all trees, grass and other vegetation as closely to the ground as practicable, burning or otherwise removing all debris, thoroughly disinfecting all areas subject to pollution, digging out stumps in the vicinity of the flow line, and the general elimination of all active organic matter immediately previous to flooding the reservoir. With immediate filtration there was believed to be no adequate reason which would justify the great expenditure necessary for general stripping, and the stripping of soil will be limited to the areas necessary to furnish so much of this material as may be required in connection with the construction of the Scituate Dam and other structures."

For the Providence Water Supply Board Frank E. Winsor, formerly a department engineer on the Catskill Aqueduct, New York City, is chief engineer.

Increase Water Storage at Pueblo, Col.

Work has been started on additional storage facilities for the City View reservoir and irrigation system located west of and adjacent to the city of Pueblo, Col. Water for the irrigation of at least 500 additional acres of land will be impounded. The present dam is to be increased to 37 ft. in height and 300 ft. long. In addition, a pressure tower 39 ft. high will be built, as well as a pumping plant for raising water to the ground on higher levels than the reservoir.

Plotting Water-Turbine Characteristics

Charts Show Relations Between Variables in Equations—Permit Quick Estimate of What Runner Will Do Under Various Conditions

By JESSE W. SHUMAN

Treasurer Power Engineering Company, Consulting Engineers, Minneapolis, Minn.

THE CONSTRUCTION of charts for water-turbine characteristics will repay any engineer engaged in hydraulic power work, as by so doing much time spent on tedious arithmetic is saved. The greater the care used in constructing the curves, the more accurate will be the results, and with reasonable accuracy the results will be correct to within less than 1 per cent. The values taken from the charts will be sufficiently close, especially as manufacturers usually discount test results in making guarantees. The writer has not recently seen logarithmic paper used for the construction of straight-line charts of equations which, if plotted in their original forms, would produce curves. Therefore, he feels that the following suggestions will be of interest.

THE EQUATIONS COMMONLY USED

The equations widely used for comparing the performance of water turbines of different diameters and under varying heads and speeds are as follows:

$$N = N_1 \sqrt{H} \quad (1)$$

$$Q = Q_1 \sqrt{H} \quad (2)$$

$$N_1 = ND/D_1 \quad (3)$$

$$P = P_1 H^{3/2} \quad (4)$$

and

$$P = P_1 D^3/D_1^3 \quad (5)$$

Where N = number of revolutions per minute under head H ; N_1 , number under 1-ft. head; Q , discharge in second-feet under head H ; Q_1 , discharge in second-feet under 1-ft. head; P , horsepower developed under head H ; P_1 , horsepower developed under 1-ft. head; D , diameter in inches of turbine to be compared, and D_1 , diameter in inches of a tested turbine.

One way to determine the size of a turbine runner,

and its speed and discharge, to develop a certain amount of power under a known head, is to refer to a Holyoke test of a runner of homologous design. By the use of the foregoing equations we can estimate the size of the runner, as well as other of its characteristics, directly from test data. Our problem may be to check up guarantees made by a manufacturer, and several different heads may be under consideration. While these equations are easily solved, it requires a certain amount of work to lock up square roots and three-halves powers of numbers. Inasmuch as an analysis of a turbine sometimes calls for working from two ends, namely, from test to actual operating conditions, or vice versa, considerable figuring is necessary. The use of logarithms expedites matters, but they too are tedious and require time. If care is taken in constructing the charts on logarithmic paper, the results will be correct to within less than one per cent.

The charts show the relations existing between the different variables in the equations 1 to 5 inclusive. They require only an explanation of their construction to enable one to make comparisons quickly, or to ascertain what a runner will do under any condition of head and speed. There are other formulas, but those mentioned are the principal ones. It is possible to construct other charts expressing relations between other variables if desired.

Fig. 1 is the chart for equations 1 and 2, which can be rewritten in their logarithmic forms as follows:

$$\frac{1}{2} \log H = \log N - \log N_1$$

and

$$\frac{1}{2} \log H = \log Q - \log Q_1$$

First consider equation 1. The divisions on the hori-

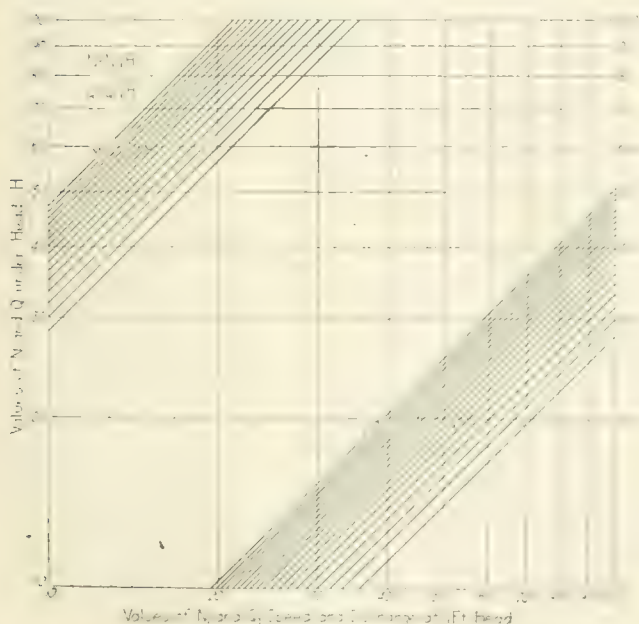


FIG. 1—CHART FOR EQUATIONS 1 AND 2

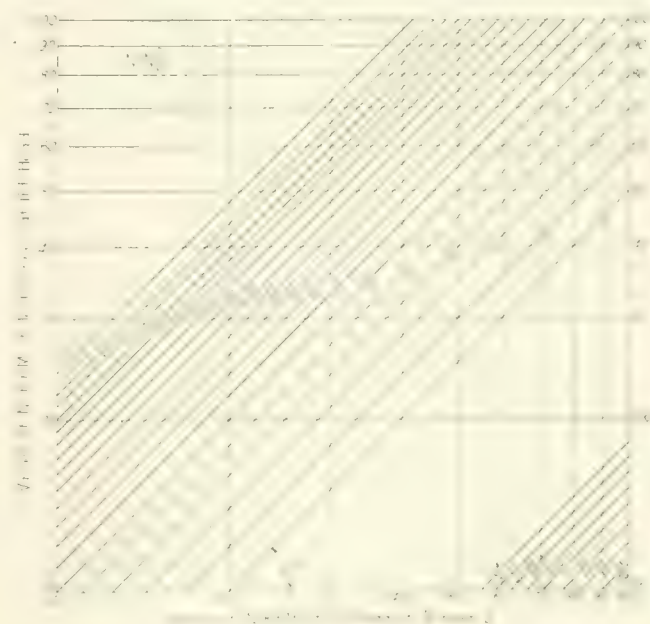


FIG. 2—CHART FOR EQUATION 3

zontal axis are numbered from 10 to 100, corresponding to the unit speed of a turbine runner at 1-ft. head. The divisions on the left-hand vertical axis are also numbered from 10 to 100, and correspond to values of the speed of the runner under the head H . The diagonal lines are each numbered for a different head and are constructed as follows: Take two different values of N and solve the equation $N = N_1 \sqrt{H}$ for N under a certain head H . This gives two points on the diagonal line. For example, assume that $N_1 = 20$ and 30 and $H = 9$. Then $N = 20\sqrt{9}$, or 60, and $N = 30\sqrt{9}$, or 90.

These values of N are laid off over verticals erected at points corresponding to values of N_1 (20 and 30 respectively). A line is now drawn connecting the intersections, as $H = 9$. One sees at a glance that for a

the speed under 8-ft. head would be 56.6. We can read backward by reversing the procedure.

EQUATIONS 2 AND 3

Inasmuch as equation 2 is identical in form with equation 1, and owing to the fact that the unit speeds and discharges in cubic feet per second under 1-ft. head are very nearly the same, similar notations on both axes will serve for equations 1 and 2. The tangent of the angle these lines make with the horizontal is equal to 1, which is the tangent of 45 deg.

Equation 3 can be rewritten in its logarithmic form, which is $\log D/D_1 = \log N_1 - \log N$.

In this equation D_1 and N_1 are the diameter and unit speed of the test runner. In this case the diameter is

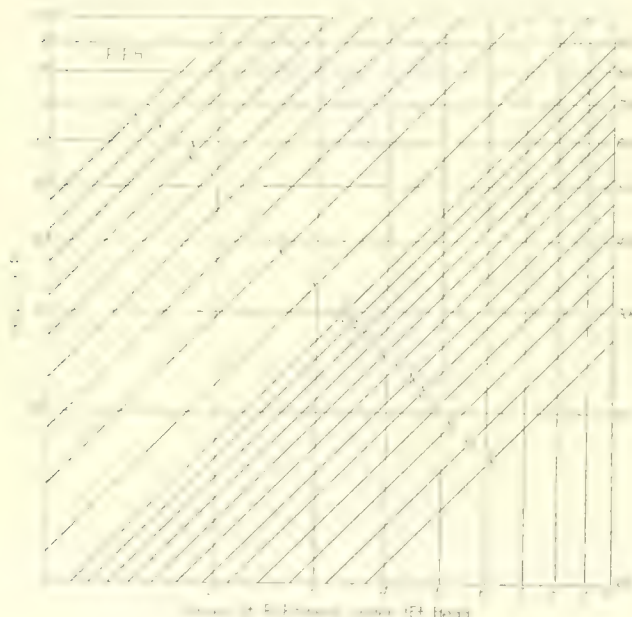


FIG. 3—CHART FOR EQUATION 4

runner speed of 20 at 1-ft. head, the equivalent speed of the same runner under a head of 9 ft. is 60.

In laying out the lines for other heads, as $H = 10$, 11, 12, etc., it is necessary to solve the equation for only one point, and draw lines through these points parallel to the master line. When a head of 12 ft. is reached a vertical erected over the unit speed of 30 would not intersect the line $H = 12$ within the limits of the chart. Consequently the line $H = 12$ is started again at the bottom of the chart. It will be noted that the lower end of the second diagonal is directly below the top end of the first diagonal, and that the divisions on the right-hand vertical axis are numbered from 100 up. In other words, using these charts is quite similar to using the slide rule. We must know which end to use, according to the values under consideration.

After a master line is drawn—having been located accurately by solving for two points on it as far apart from each other as possible—all other lines, for as many different heads as desired, are drawn by solving for one point only, and drawing a line through each point parallel to the master line. The chart shows lines up to $H = 26$ ft. If we note by Holyoke test, reduced to 1-ft. head, that the runner's speed is 50, its speed at 8-ft. head would be 140. If its unit speed at 1-ft. head is 20,

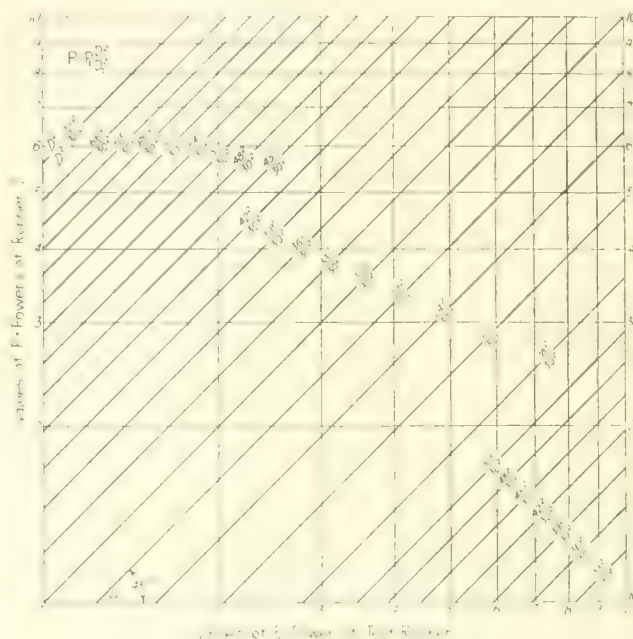


FIG. 4—CHART FOR EQUATION 5

assumed to be 30 in. The chart for equation 3 shows a series of diagonal lines, marked from $D/D_1 = 30/30$ as the master line, down to $D/D_1 = 15/30$ and up to $D/D_1 = 72/30$. In constructing the chart, we solve for points and use the different ratios of D/D_1 . The unit speeds under 1-ft. head for test runner are shown on the vertical axis; the unit speeds for the runner of diameter D at 1-ft. head are shown on the horizontal axis. Both axes are numbered from 10 to 100, the vertical axis at the right-hand lower corner being numbered from 100 up. To construct this chart, start with the diagonal line, which represents a ratio of $D/D_1 = 30/30$. Assuming values of $N = 30$ and 50, N_1 will equal 30 and 50. This gives two points on the diagonal lines, which will make an angle of 45 deg. with the horizontal. By solving this equation, with the same value of $N = 30$, and with different values successively of D/D_1 , we obtain one point for each line. Draw lines through each point and parallel to the master line. We see now that if a 48-in. runner is under discussion and is of homologous design with the tested 30-in. runner, its speed under 1-ft. head will be 20 if the test runner's speed is 32, or will be 37.5 if the test runner's speed is 60.

Equation 4, $P = PH^3$, in its logarithmic form reads $3 \log H - \log P = \log P_1$. This equation is used

to compute the power of a runner at any head if its power at 1-ft. head is known. The chart is constructed as were the others. The horizontal axis represents powers at 1-ft. head and is numbered from 1 to 10. The vertical axis represents powers under the head H and is laid out on the left from 10 to 100 and on the right from 100 to 1000. The chart shows diagonal lines marked $H = 5$ up to $H = 20$. A master line is first drawn, located by solving the equation for two points. The other lines are drawn parallel to the master line through the points located by solving the equation. Looking at the finished chart, we see that if $P_1 = 6$, the same turbine, at the same efficiency, would under 9-ft. head develop about 163 hp. Or, if it develops 2 hp. at 1-ft. head, at 13-ft. head it should develop about 93.7 hp.

The logarithmic form of $P = P_1 D^2 / D_1^2$ is $\log D^2 / D_1^2 = \log P - \log P_1$. In this equation, P and D are the power and diameter of the runner under discussion, and P_1 and D_1 are the power and diameter of the test runner. The chart, very similar to Fig. 2, shows a series of diagonal lines marked, in this case, as the ratios of D^2 / D_1^2 . The same number of lines is shown, but the relative positions on the chart differ.

The chart is constructed by the same method as the others, and particularly like that in Fig. 2. The horizontal axis represents values of P_1 and is numbered from 1 to 10 as unit powers. The vertical axis represents values of P and is numbered from 1 to 10 on the left-hand axis, and from 10 to 30 on the right. By keeping in mind relative values, and properly locating the decimal point, this chart can be used for other heads.

USES OF CHARTS

To show some of the uses to which these charts can be put, assume that we desire to ascertain the size of a waterwheel to develop about 576 hp. under a 16-ft. head at 120 r.p.m. (a synchronous speed).

Fig. 1 shows that a runner rotating at 120 r.p.m. under a 16-ft. head would run 30 r.p.m. under 1-ft. head.

Fig. 3 shows that if a runner develops 576 hp. at 16-ft. head, it would develop 9 hp. at 1-ft. head.

Referring to Fig. 4, we see that the horizontal line from 9 hp. (on the vertical axis) crosses diagonals from $72^\circ/30^\circ$ to $30^\circ/30^\circ$. At first thought it would seem that there would be a large variation of runners that would fulfill our conditions. That would depend upon their design and ability to develop, at 1-ft. head, the unit powers shown at the foot of each vertical dropped from the point of intersection of the horizontal line (9 hp.) and the diagonals. To select a possible and commercial size it is necessary to consult the Holyoke tests of available types and to note, by inspecting their performance, an efficient unit power. Suppose we note by a test sheet that unit powers of a 30-in. runner are possible, at good efficiency, between 4 and 5 hp. The diagonal line $45^\circ/30^\circ$ intersects the horizontal line from $P = 9$ hp. at a vertical erected over the unit power of 4. This shows that a 45-in. runner of the same design as the test runner would answer our purpose. The 45-in. runner will revolve at 30 r.p.m. under a 1-ft. head. Therefore, by looking again at Fig. 3, we see that this means a speed of 45 r.p.m. for the test runner. If the test data show that at this speed the efficiency is good, the size selected will be approximately correct.

We can also work from the test data end, and finally

arrive at the size and resulting speed of the runner. In case the speed so secured is not synchronous, and the turbine is for direct connection to an alternator, it will be necessary to work back and forth until the proper synchronous speed is secured.

Soldiers Construct Mess Halls at Fort Sam Houston, Texas

Details of Material Used and Methods Adopted Are Given—Thirty Men Build One 20 x 64-Foot House Per Day

By CHARLES S. DUKE
Chicago

THAT the scope of activities to be performed by the modern soldier has been greatly enlarged in recent years is attested by the construction of a large number of mess halls by the militia and regular army at Fort Sam Houston, Texas, during last summer. Sanitation,



TYPICAL VIEW OF MESS HOUSES CONSTRUCTED BY SOLDIERS

the war waged upon germs, has been found no less important than action against a hostile enemy. In using soldiers on construction work the authorities were well within the power granted by the army regulations. It was the extent to which this was done that has been the cause of some comment.

In the typical case of an infantry regimental unit, there were built, usually, nineteen mess halls, six 20x36 ft. and thirteen 20x64 ft. Of the smaller size, one was

MATERIALS USED IN BUILDING FOR LARGER SIZE HOUSES.			
No. of pieces.	Size.	Length.	Description.
4	2 X 4	20 ft.	
16	2 X 4	16 ft.	Sills and plates.
7	4 X 4	18 ft.	Posts.
2	2 X 4	12 ft.	Braces.
4	2 X 4	20 ft.	
14	2 X 4	14 ft.	Studs.
9	2 X 4	16 ft.	
	2 X 4	18 ft.	Ribs.
18	1 X 4	16 ft.	
7	1 X 4	18 ft.	Belt and ead.
4	1 X 4	16 ft.	
8	1 X 4	18 ft.	Base.
8	1 X 8	16 ft.	Frieze.
7	2 X 4	18 ft.	
4	1 X 6	14 ft.	Collar beam.
7	1 X 6	20 ft.	
4	1 X 6	16 ft.	Ties and ridge.
6	2 X 4	16 ft.	
4	2 X 4	8 ft.	Vents.
8	2 X 4	18 ft.	Rafter.

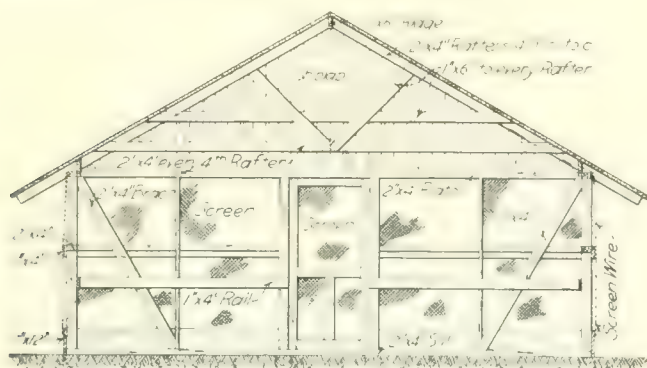
2200 ft. b.m. roofing, 140 ft. b.m. chapap gaboon, 1 sheet doors 3 x 6 ft. 8 in., 188 lin. ft. 36-in. screen wire, 188 lin. ft. 36-in. screen wire, 10 in. ft. 18-in. screen wire, 26 sq. ft. 2 ply roofing paper, 10 lb. lead nails, 200 lb. sd. nails and 1 lb. screen nails.

used for headquarters, three for battalion, one for supply and one for headquarters company. Of the large size, one was used for the machine-gun company and the remaining twelve for companies of the line. The center line of each of the larger halls, which were located at the head of each company street and flanked on the left by the headquarters-company mess hall and on the right by the supply-company mess hall, coincided with the center line of the row of company tents.

DETAILED LIST OF MATERIAL USED

The materials used were pine lumber, tar-paper roofing and wire screening. The bill of materials for each of the larger size houses is given in the table on page 387.

A commissioned officer was detailed in charge of the work and was held accountable both for labor and materials. The execution of various parts of the work



CROSS-SECTION OF BUILDING SHOWS MATERIAL USED

was under the immediate charge of non-commissioned officers, the work usually being divided into carpentry, roofing, teaming, and general labor. The carpentry was done by the company mechanics, there being one detailed from each company to the construction gang. Special details of other soldiers from such companies as seemed to afford the best material completed the construction organization, which amounted usually to between 30 and 50 men. A civilian carpenter was employed to work with the carpenter squad.

ONE HOUSE COMPLETED EACH DAY

After one or two houses were constructed, the men were sufficiently trained and proceeded rapidly with the work. A squad of 30 men working nine hours a day usually completes one house per day. The progress of the work was greatly facilitated by an undercurrent of rivalry existing among various regiments.

At one end of the building and near the kitchen door was built a brick incinerator, upon which were mounted a Sibley stove and a galvanized pan 6 in. by 2 x 4 ft. for evaporating liquids. Over the ash-pit grate bars were installed for drying out solid garbage. About 500 bricks were used in the construction of each incinerator.

Where Four Miles a Day Is Speed

During the five-year period ended in 1914 Georgia surfaced 6364 miles of her roads. This is at the rate of more than 4 miles per working day.

Low-Grade Dynamite and the Labor Shortage

Even Blasting of Soft Materials to Insure Capacity Operation of Excavating Tools Now Found Profitable

PROBABLY one of the chief labor-saving developments in the construction field resulting from the increasing cost and scarcity of common labor is the recent development and use of the lower grades of dynamite, according to E. I. du Pont de Nemours & Company. In rock, the efficiency of and the necessity for using dynamite have long been recognized, but when this high-grade explosive was applied to earth excavation the results were far from satisfactory. This, of course, is due to the fact that rock work requires a quick-acting, shattering force, while in earth a comparatively slow-acting explosive with a heaving or lifting effect is desired. Recognizing the usefulness of such an explosive at the present time, manufacturers have developed a low-grade dynamite for this purpose. This explosive, having a slow, heaving action, is comparatively insensitive and safe to handle. It is also low-freezing. Contractors are now using it in conjunction with all types of mechanical excavators to hasten and cheapen the work.

LOOSENS COMPACT EARTH FOR STEAM SHOVEL

The method generally pursued is to do the drilling or punching of the bore holes and the firing at a time when it will not interfere with other operations. Even where the steam shovel is used, it frequently pays to loosen the material ahead where large boulders, compact earth or hardpan is encountered. To secure the maximum efficiency of the machine, the shovel must be filled at every trip. On this account it is no longer profitable in hard digging to make the shovel do very much ripping and loosening of the material, or to operate it far below full capacity. Often the use of a little explosive on large boulders, stumps or other obstructions saves a broken cable and consequent delays.

ALSO AN AID TO LIGHTER TOOLS

On dredge-bucket excavation where it is difficult to secure full loads, good results can frequently be obtained by loosening the bottom with light blasts. In shallow excavation, where scrapers, elevating graders and similar tools are used, plowing is usually resorted to to loosen the soil sufficiently for these machines to handle it. In compact ground, where stumps and roots are encountered, or where there is little room in advance of the cut to drive and turn horses or operate tractors, such plowing represents a labor expense which has increased to considerable proportions. By the proper use of low-grade explosives this expense may be largely eliminated. Hand picking and shoveling in corners may also be dispensed with at considerable saving by the use of such explosives. Where the work is so restricted that only hand labor is practicable, still greater economies are possible.

Excavation carried out while the ground is frozen is always expensive. In some cases, however, work must be carried on during cold weather, and under these conditions dynamite is one of the most efficient labor-savers.

Compares Flat-Slab Design Requirements in Light of Test Results

A. R. Lord Believes Recommendations of Joint Committee to Be Ultra-Conservative—Advocates Modified Concrete Institute Values

FLAT-SLAB design recommendations of the Joint Committee on Concrete and Reinforced Concrete, accepted at the last annual meeting of the American Society of Civil Engineers (see the Engineering Record of Jan. 13, page 55), are compared with the recommendations of the Committee on Reinforced Concrete and Building Laws of the American Concrete Institute (accepted at the last annual meeting, but not to be sent to letter ballot until next year) by A. R. Lord in a paper presented before the Southwestern Cement Association on Feb. 22.

Reviewing the results of tests of four buildings in Chicago, Mr. Lord concludes that the Joint Committee values are ultra-conservative and recommends modified values, with a different steel distribution for the two-way and four-way systems. Tables and diagrams, some of which are here reproduced, show the varying percentages for the moment requirements, the average results of tests compared with values computed according to the Chicago ruling, and the distribution between diagonal and direct bands as indicated by these tests.

COMPARISONS WITH CHICAGO RULING

Among city building regulations the flat-slab code of the Chicago Building Department was the first to be adopted. It is still the most conservative and has found wide acceptance among building departments from coast to coast. It was based on the work of five expert commissions appointed to establish design standards for use in Chicago. The reports of the Joint Committee and the Concrete Institute Committee (Mr. Lord was a member of the latter) are compared with the established values of the Chicago ruling and the data of tests of buildings designed in accordance with Chicago practice, as Mr. Lord believes that flat-slab design must necessarily be largely based on test and service records of actual buildings.

The accompanying Table 1 (rearranged and slightly modified to give consistent values) is taken from a discussion by T. L. Condon before the American Concrete Institute. It shows the equivalent coefficient for total sum of positive and negative moments and the percentage of distribution allowable to the different sections, defined as shown on the diagram herewith.

As indicated in Table 1, the Concrete Institute report and the Chicago ruling have the same total moment coefficient. This coefficient is the highest in any building code in the United States and the highest heretofore used in practical designing. It represents the most conservative past practice. The Joint Committee report increases this moment 18.5 per cent.

TABLE GIVES SUMMARY OF CHICAGO TESTS

Table 2 gives a summary of four Chicago tests, all of four-way flat slabs of the drop type. All these floors were loaded up to or in excess of twice the total dead and live design load. These tests seem to indicate eminently safe and conservative design. The average steel stress measured at the support was about 9000 lb. per square inch, against a computed stress of about 27,000 lb., using the Chicago ruling. The measured concrete stress was about 700 lb. per square inch, against a computed value of about 1250. At the panel center the average steel stress measured about 13,000 lb. per square inch, against a computed value of 37,000 lb. The concrete stress at the center is always very low—less than half that at the supports. The average stress in the top rods was less than 8000 lb. per square inch, against a computed value of over 70,000 lb. Taking into account the possible and reasonable effect of various loadings and of long continued loading, it would appear that a factor of safety of four was largely exceeded.

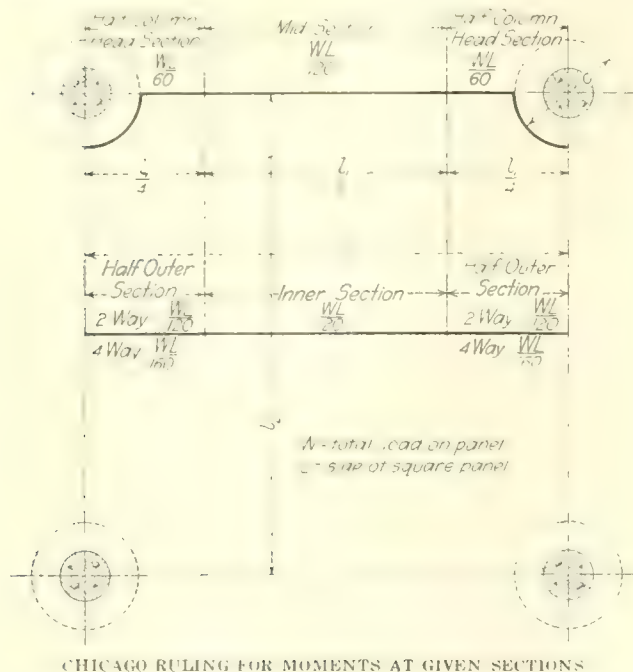
COMPUTED MOMENTS FROM MEASURED STEEL STRESSES

Computations of the various resisting moments from the measured steel stresses, even on an extremely conservative basis, show an average total sum for positive and negative moments of $0.025WL$, which is equivalent to a coefficient a of 0.035 in the equation $M = awl(l_2 - qc)^2$, as against the value of 0.090 given by the Concrete Institute committee. One of the tests reported, that of the Schwinn Building, involved measurements under load for a full year (see Engineering Record of March 3, page 341), and the increase in the total moment was about 7 per cent, with no increase during the last three or four months. In one test at Seattle (see the Engineering Record of May 13, 1916, page 746) in which

TABLE 1—COMPARISON OF DESIGN REQUIREMENTS FOR FLAT SLAB FLOOR CONSTRUCTION

Authority	Type	Coeff.*	—NEGATIVE MOMENT IN PER CENT—			POSITIVE MOMENT IN PER CENT			Total Sum
			Column Head	Mid-section	Total	Outer Section	Inner Section	Total	
Joint Committee . . .	Drop	0.107	50	12.5	62.5	28.1 to 32.3	9.4 to 11.4	37.5	100
	No drop	0.107	50 to 49.6	12.5 to 21.9	62.5	28.1 to 30.4	9.4 to 16.7	37.5	100
Concrete Institute	Drop	0.090	60 to 50	10 to 20	70 to 60	18 to 28	12 to 32	30 to 40	100 (net more)
	No drop	0.090	60 to 40	10 to 30	70 to 50	18 to 38	12 to 32	30 to 50	100 (not more)
Chicago Ruling	Four-way	0.087	53.4	13.3	66.7	20	13.3	33.3	100
	Two-way	0.093	50	12.5	62.5	25	12.5	37.5	100
Akme Standard Two-way	Drop	0.096	47	13	60	7	13	20	100
	No drop	0.096	45	12.5	57.5	30	12.5	42.5	100

* Coefficient equivalent to a in the expression for total moment $M = awL (L - \frac{1}{2}c)^2$, where w is dead and live load per square foot, L is side of square panel, and c is diameter of round column head.



exceedingly high stresses were developed, reaching 50,000 lb. per square inch in the steel, the equivalent coefficient for total resisting moment was only 0.066, as against 0.090 specified by the Concrete Institute committee.

DISTRIBUTION OF THE TOTAL MOMENT

The question as to the amount of total moment to be specified in design, says Mr. Lord, is one of conservative versus ultra-conservative opinion. The distribution of the total moment, however, does not admit of so many opinions. The Joint Committee report makes a rigid division of the moment into 62.5 per cent negative and 37.5 per cent positive for any or all types of flat slab. The Concrete Institute committee report leaves a portion of the moment to be assigned in accordance with the physical details of the slab and its reinforcement. If the Joint Committee division is right for a flat slab with a drop and supported by stiff columns, it is wrong for a flat slab without a drop and supported by relatively slender columns.

The evidence of the tests is positive and conclusive on this. For four panels loaded uniformly, the tests show a distribution of approximately $\frac{5}{8}$ negative and $\frac{3}{8}$ positive moment, with individual cases in which as high as 70 per cent of the total moment has been negative, for buildings with a much deeper drop than the Joint Committee permits. With other conditions of loading, certainly the center or positive moment would be greater and the ratio of negative moment to total moment reduced. With no drop present, the change

would be even greater, as shown in the test of the Bell Street warehouse at Seattle, already referred to, where only 40 per cent of the total moment was negative and 60 per cent positive—practically a reversal of the conditions where a large drop is used.

These data give ample basis for the Concrete Institute committee recommendation that permits an extreme division of 50 per cent negative and 50 per cent positive where the drop is not used, and also permits from 60 to 70 per cent negative where the drop is used.

DISTRIBUTION DIFFERENT IN TWO-WAY AND FOUR-WAY SYSTEMS

The Joint Committee assigns a fixed proportion of 12.5 per cent of the total moment to the mid-section in flat slabs with a drop. This does not allow for the fact that the distribution of the moment is different in two-way and four-way flat slabs—a fact clearly brought out in tests. In four-way flat slabs of the Schwinn Building, as shown in Table 2, the calculated stress across the mid-section was over 70,000 lb. per square inch and the actual stress under 10,000 lb. per square inch, even after a year. In the test of the Sears Roebuck Building at Seattle, a two-way flat slab gives a computed stress at this section of 27,200 lb. per square inch and an actual stress of 23,500 lb. per square inch.

This would indicate that the moment across the mid-section is several times as great with the two-way arrangement of the steel as it is with the four-way arrangement. The Joint Committee assignment of moment to this section is too large for four-way slabs and too small for two-way slabs, and the result is an unbalanced design. The Concrete Institute report permits a distribution that will fit either type.

Customary practice in four-way design makes a distribution of the steel between direct and diagonal bands varying from a 1 to 1 ratio to a 1.5 to 1 ratio, and the results of tests as shown in Table 3 indicate that these ratios are about right. The average distribution of the moment was about even between direct and diagonal bands, and this would result in a 1.4 to 1 ratio between direct and diagonal bands. The Joint Committee report specifies as a minimum that 60 per cent of the positive moment must be taken by the outer section, and this gives a minimum relation of 2.1 times

TABLE 1. COMPARISON OF TEST RESULTS AND COMPUTED VALUES

Test	STRESSES OVER COLUMN HEAD ¹		STRESS IN CONCRETE		STEEL STRESSES		—Top rods—	
	Test	Chicago ²	Test	Chicago ²	Test	Chicago ²	Test	Chicago ²
Franks	6,200	23,700	1,110	1,400	10,100	31,000		
Larkin	8,700	23,000	800	1,120	16,000	37,000		
Schulze	7,100	22,000	530	1,230	6,200	34,000	4,900	71,500
Schwinn	9,200	18,000	300	1,160	18,900	39,000	9,900	70,000

¹Average of readings in fully loaded area.

²Average of readings on direct and diagonal bands.

³Observed steel stresses as reported in tests.

⁴Stresses calculated by Chicago ruling for a design load equal to applied test load.

⁵Concrete stresses reduced to 80 per cent of those reported for the tests and computed on the basis of the initial modulus of elasticity.

⁶Stresses given are for readings taken with full test load in place over one year.

TABLE 2. DISTRIBUTION OF TENSION BETWEEN DIRECT AND DIAGONAL BANDS

Test	STEEL AREA IN SQ. IN.		OBSERVED STEEL STRESS—			TOTAL TENSION		PER CENT OF WHOLE	
	Two ¹ diagonal bands	Long direct band	Diagonal band	Long direct band	Short direct band	Diagonal bands	Direct bands	Diagonal bands	Direct bands
Franks	10.00	3.54	6,950	7,350	10,100	69,000	57,000	54.8	45.2
Larkin	11.13	5.10	12,900	10,200	24,200	143,800	113,800	55.9	44.1
Schulze	8.48	2.45	4,220	8,400	7,200	36,000	47,400	43.2	56.8
Schwinn	11.88	1.0	21,900	16,000	18,600	304,000	159,000	65.6	34.4
Average									54.9

¹Effective section.

as much cross-sectional steel area in the direct as in the diagonal bands.

MOMENTS IN COLUMNS

The amount of moment developed in the columns will depend on the type of flat slab and on the stiffness of the columns above and below the slab. For small columns in upper stories of buildings the Concrete Institute specification of coefficient $a = 0.022$ should be ample even where the drop type of flat slab is used. This is a matter where the judgment and calculations of the engineer must decide, but the specification of a definite minimum moment by the Concrete Institute committee seems a step in the right direction. The Joint Committee report and the Chicago ruling leave this in a very indefinite shape, with the result that many designers will entirely overlook the design of the columns for bending moment.

RECOMMENDED DESIGN AND CONSTRUCTION SAFEGUARDS

For engineers designing structures to be erected by the most improved means under positive controls insuring a superior grade of concrete, Mr. Lord recommends the use of the Concrete Institute report, with a moment coefficient of 0.080 instead of 0.090 given by them. For four-way flat slabs with drops, which is the economical type to use, he advises the following distribution of the total moment: Column-head section, 50 per cent; mid-section, 10 per cent; outer section (direct bands), 20 per cent; inner section (diagonal bands), 20 per cent. Where no drop is used, take from 6 to 10 per cent (depending on the column stiffness) of the total moment from the column-head section and distribute it equally over the inner and outer sections. For two-way flat slabs with drops, the following distribution of the total moment may be taken: Column-head section, 50 per cent; mid-section, 15 per cent; outer section, 23 per cent; inner section, 12 per cent.

The engineer's drawings in every case should show a positive mechanical means for securing the reinforcement in the position contemplated in the design. The builder may be permitted to substitute any equally effective means of his own choice, of course, but some adequate device should be shown on the plans so that the builder and the inspector may know absolutely where the steel belongs. Many current plans do not properly take care of this requirement of good construction. The proper fireproofing cover for the rods is very commonly left to the contractor, with bad results. This matter of proper fireproofing of the reinforcing rods is more important than a variation of 10 per cent in the design moments, and engineers cannot take too much care to guard their structures in this respect.

Mr. Lord concludes by stating that he favors the use of high-carbon steel in all flat slabs, for the reasons that it is less easily bent accidentally at places not intended and that it affords a greater ultimate factor of safety as shown by tests, and costs no more than structural-grade steel.

Misleading Maintenance Figures

A source of misunderstanding regarding the expenses of road maintenance lies in the fact that the traffic on some roads has increased to an amount for which the pavement is unsuited.

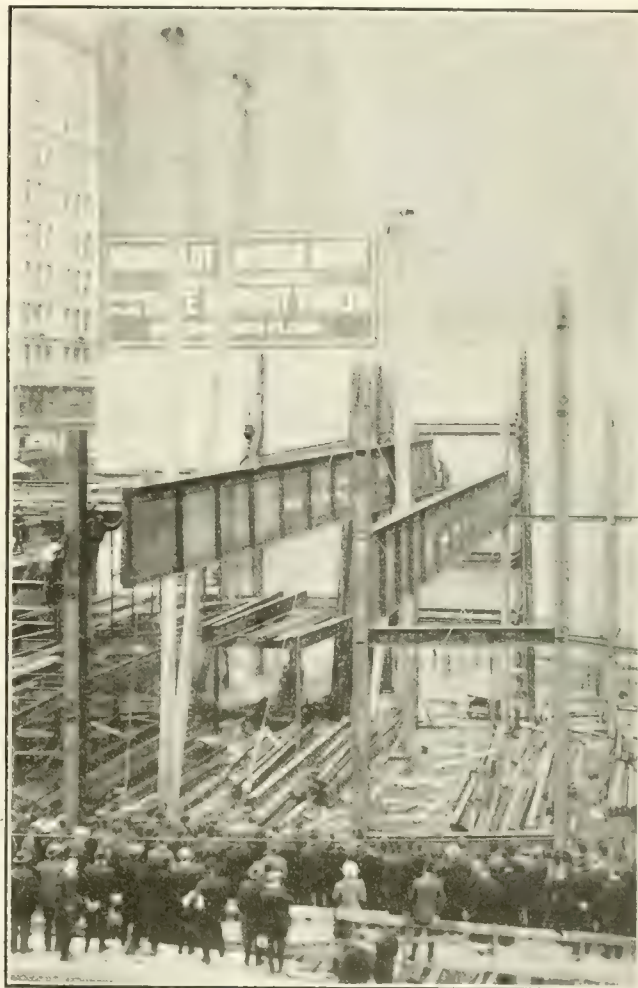
Place Two 88-Foot 35-Ton Girders in San Francisco Theater

Two 90-Foot Guy Derricks Raise Them 36½ Feet in 12 Minutes—Largest Girders Ever Used in Building on Pacific Coast

By J. J. ROSENTHAL

Safety Engineer, Industrial Accident Commission

TWO plate girders, 8½ x 88 ft., fabricated in one piece by Jones & Laughlin, of Pittsburgh, and weighing 35 tons each, were recently placed in a San Francisco theater. These girders, which are the largest ever used on a building on the Pacific Coast, were erected by the Dean Construction Company and were



PLACING 35-TON GIRDER FOR THEATER BALCONY

placed in the California Theater, Fourth and Market Streets.

The girders supporting the balcony were lifted to a height of 36½ ft. in 12 minutes by two guy derricks specially designed for the task. The derrick timbers were 24 x 24-in. Oregon fir; the masts were 90 ft. long and the booms 85 ft. Each mast was anchored by ten 1½-in. cables running to concrete piers.

The girders were clamped and lifted by two cast-steel dogs, each weighing 250 lb., handled by blocks with seven 1-in. steel cables composed of eight strands of nineteen wires each. The hoisting rig held the girders in position until seventy-eight rivet holes at

each end were bolted to the 14 x 14-in. columns with drift pins. These pins were soon replaced one by one by $\frac{7}{8}$ -in. hot rivets.

The writer, in the capacity of construction engineer for the Safety Department of the Industrial Accident Commission of California, supervised the erection and attempted to see that every possible safety precaution was taken.

Commission Urges Use of Water Power for Nitrate Manufacture

California Water Conference Compares Highly Developed Field Abroad with Failure to Utilize Power in This Country

THE attention now being directed toward the use of hydroelectric power in the manufacture of nitrates has led the State Water Problems Conference, appointed by the governor of California, to devote considerable space to this subject in its recent report, an extract of which appeared in the Engineering Record of Jan. 27, page 140. In order to emphasize the latent possibilities in this field in the United States, comparisons are drawn with the nitrate industry in foreign countries. The following has been taken from the report.

SMALL CROP YIELDS FROM U. S. LANDS

Europe uses per acre of cultivated land 200 lb. of fertilizer; the United States uses 28 lb. Germany, in twenty years, by the use of fertilizer has increased the average yield of all crops grown three and one-half times as much per acre as America. The German Agricultural Department reports show that by feeding the soil with 2,000,000 tons of nitrate there was secured an increase in crops of 63,000,000 tons. In Germany intelligent effort has been directed to replace the nitrogenous compounds extracted from the soil by crop growth; in the United States the average agriculturist has seen his land yield steadily decreasing crops without attempting adequate remedy.

The average yield per acre in bushels for various crops in the United States and in Europe is as follows:

	Wheat	Oats	Barley	Rye	Potatoes
Europe	32	47	38	50	148
United States	15	29	25	16	96

"As a measure of preparedness in event of war," the report states, "the United States has been attempting to accumulate a reserve stock of 32,500 tons of Chilean nitrate. Her army and navy use annually in peace 3000 tons. The reserve stock contemplated would make enough explosives to last possibly a week in a modern war, and at the end of that time the nation would be powerless unless her navy were strong enough to enable her to commandeer a supply from Chile, against the efforts of her enemy and possibly the wishes of the world. A cheerful outlook for a nation whose foreign relations are becoming complicated!"

NITRATES FROM THE AIR

A country with great natural water-power resources can by the proper use thereof make itself independent of the foreign supply of nitrates. Nitrates can be readily

extracted from the air by hydroelectric power, and where there is a general distribution of the necessary rock deposits used in these processes, which is the case throughout the West, it may be considered that a horsepower and a half of hydroelectric energy will produce a ton of sodium nitrate per year. The method of manufacturing fertilizer from Chilean deposits produces a composition of 12 per cent active fertilizer and 88 per cent useless material on which freight must be paid, while the electro fertilizer product contains 60 per cent of fertilizing material.

The United States is importing from Chile annually 625,000 tons of nitrate, valued before the war at \$23,000,000 (including the Chilean export duty of nearly \$8,000,000), but now worth \$37,500,000. That entire amount of nitrate could be manufactured in California by utilizing 1,000,000 hp. of its unused water power resources. California itself is using about 50,000 tons of Chilean nitrate annually at a cost before the war of nearly \$2,000,000; increased now to \$3,000,000. Many times this amount should now be used annually in that state, and this will doubtless come in time. A 75,000-hp. hydroelectric plant would supply the nitrates now used in California.

Syllabus of Co-operative System at University of Cincinnati

Object, Method, Matter and Mechanism Set Forth by C. W. Park in Bulletin Issued by U. S. Bureau of Education

A UNIFORM outline of the object, method, matter and mechanism of each course in the co-operative system of education, which has now been in operation at the University of Cincinnati for more than 10 years, has been adopted and is tabulated by C. W. Park, associate professor of English at that institution, in a bulletin on "The Co-operative System of Education," issued by the U. S. Bureau of Education. The objects were first stated by Dean Schneider in 1902 practically as given in the first column of this table, which is here reproduced.

The methods originally suggested for accomplishing objects 7 and 8 have not been found feasible without certain features not readily obtainable at Cincinnati. However, a new method, new matter and new mechanism have been devised for object 8 to meet the situation at Cincinnati, and these are now in the experimental stage. Methods differ more widely than objects for the different courses, and manifestly the subject matter is, or should be, entirely different for the different courses. In fact, such an extensive survey of the curriculum has its main advantage in avoidance of duplication of subject matter.

GENERAL PRINCIPLES OF CO-OPERATIVE SYSTEM

Comparing the earlier with the later courses after reorganization, omitting certain details and changing of emphasis on others constitute the principal features of the modifications made. Purely descriptive courses were discontinued, and descriptive matter in all courses was reduced to a minimum, much of it being assigned as incidental reading to be done when the student was in the shop. By reducing the time given to informa-

Syllabus of the Co-operative System in the College of Engineering, University of Cincinnati

OBJECT	METHOD	MATTER	MECHANISM
TO PROVIDE ENGINEERING TRAINING FROM WHICH THE STUDENT SHALL ACQUIRE:			
1. A foundation in the basic principles of science.	1. Instruction in science and mathematics.	1. Chemistry, physics, mathematics, economics, biology, practical engineering projects.	1. Class and laboratory work; co-ordination with practical experience.
2. Ability to use these principles in practice.	2. Gradual and natural advancement in practical work which uses these principles. Concurrent training in the theory and practice of engineering.	2. An organized sequence in practical work. An organized sequence in science.	2. Co-operation with commercial concerns doing engineering work. Alternate periods spent by two groups of students at school and at practical work.
3. An understanding of engineering in general, as well as of one special department.	3. Varied exemplifications of theory in the classroom. Organized visits to a variety of engineering industries. Contact with fellow students in different kinds of engineering work.	3. Experiences of students in different types of work correlated with theory. Visits to waterworks, foundries, soap works, etc.	3. Co-ordinators and students furnish illustrations. Organized shop visits.
4. A working knowledge of business forms and processes.	4. Instruction in economics, management, etc. Reports on shop visits, analysis of shop processes. Practical experience in business forms and procedure.	4. Fundamental principles of economics (systems, forms, contracts, patents in engineering work, etc.) Reports on organization and operation of waterworks, foundries, soap works, etc. Routing of work in shops, time-keeping, rate-setting, cost-keeping, etc.	4. Co-ordination of classroom work with students' experience. Practical training organized by co-ordinators to insure experience in business forms and processes.
5. A knowledge of men as well as of matter.	5. Personal work with men from laborers up to superintendents or managers. Instruction in the basic elements of work.	5. Practical work, from laboring to directing. Fatigue, wage systems, employment methods, sanitation, etc.	5. Prearranged course of practical training.
6. Drill and experience in the following essentials:			
(a) Doing one's best naturally and as a matter of course.	(a) By regulating promotion and pay on practical work. By maintaining a satisfactory standard in college work.	(a) Practical performance; classroom performance.	(a) Constant supervision and criticism of student's practical work. Consultations by college officials on advancing students on jobs. Internal co-ordination of college departments; conferences on work of students.
(b) Prompt and intelligent obedience to instructions.	(b) By working under the rules of an industrial organization. By learning the reasons why things are done.	(b) Practical work under foremen. Using practical experience in science courses. Work syllabi.	(b) Student is kept at manual labor until he learns to obey orders. Co-ordination of theory and practice. Study of work syllabi.
(c) Ability to command intelligently and with toleration.	(c) By gradual rise to positions of responsibility in the co-operating companies. By courses dealing with conditions under which men work.	(c) Practical jobs of more and more authority and responsibility. Personal experience in hard work. Fatigue, wage systems, employment methods, sanitation, etc.	(c) Success of student on practical and theoretical work checked by co-ordinators. Round table discussion in shop management courses.
(d) Accuracy and system.	(d) By practical work which requires mental and manual accuracy, and which proceeds with a sequential orderliness. By insistence in school on accurate work and orderly methods of presentation.	(d) Carefully selected jobs. Analyses of shop processes in class. All college courses.	(d) Close familiarity with outside work through visits of co-ordinators. Co-ordination between departments to maintain standards.
(e) Ability to write clearly and concisely, and to present technical matter interestingly before an audience.	(e) By constantly requiring written work under criticism, and by requiring oral presentation of technical matter.	(e) Reports on shop work. Reports on shop visits. Laboratory reports. Student engineering society papers and discussions. Class practice under criticism.	(e) Co-ordination of English department with other departments in criticizing all written work. Student engineering societies afford practice in oral presentation. Regular class exercises in presenting engineering reports.
7. Ability to meet social requirements easily.			
8. An appreciation of humanity's best achievements.			

tional studies, more attention could be given to the fundamental subjects that could be given in the regular four-year course. These features are based on the underlying principles of the co-operative course—the reality of first-hand knowledge as against a merely bookish approach, and that the school is primarily a teaching institution designed to give training that cannot easily be obtained through any other agency.

The first three years of civil, mechanical, electrical and other engineering courses were made essentially the same in theory. Thus if a student discovered during the first three years of practical experience that he was better suited to a different kind of work he could easily change his course.

MOST IMPORTANT ELEMENTS

From the employer's point of view the most important elements of the co-operative plan are: First, the selection of the workers; and, second, the awakening of an enlightened interest in their work through co-ordinated instruction. From the standpoint of the school and the student, the most important feature is the realization of theory through practical applications.

Irrigation Settlers Require Aid in Wyoming

State Engineer Proposes Sales of Public Lands to Furnish Funds for Farmers and for Building State Highways

TO PLACE the landless man on the manless land successfully, material aid is required to tide him over the pioneer period of settlement. This and the statements that follow appear in the biennial report of the Wyoming state engineer, James B. True. The time swiftly approaches, Mr. True says, when it will be absolutely necessary for some centralized public authority to give the settler assistance in establishing himself upon the land.

To-day in Wyoming, says the report, there are hundreds of thousands of acres of unoccupied land which are commanded by completed irrigation systems. The unaided settler of small means cannot hope to succeed on these lands under the present system and policies. Even individuals, endeavoring to irrigate their land by means of small private ditches, are encountering serious financial difficulties. The cost of equipping a farm alone has increased 137 per cent in the past ten years, to say nothing of the time and money required for improvements.

REQUESTS FOR EXTENSIONS OF TIME FREQUENT

Hundreds of requests for extensions of time which are received by the state engineer state that the applicant, being a poor man, is forced to work away from home most of the time in order to obtain a living for himself and family, and that his earnest efforts to reclaim his land are therefore confined to short, uncertain and unseasonable periods. Great numbers of most desirable citizens are forced by meager circumstances to spend a considerable part of their energies and lives struggling to bring their land into productive cultivation when, with proper financial aid and competent direction, this trying period would be greatly short-

ened and cheapened. The proposed state aid would enable him to devote his entire time to his farm, bring it quickly under cultivation and thus obtain from the land itself an independent living income.

There is no enacted legislation, federal or state, which will aid the new settler in the arduous, costly task of transforming raw sage-brush land into an irrigated farm. The Federal Rural Credits Act requires a first lien on improved land as security. The new settler has no such security to offer; on the contrary, he is burdened with additional liabilities during each stage of his efforts to acquire a living income and a home. The proposed federal act, which will guarantee the interest on irrigation-district bonds, in no sense applies to the problem here presented. Such a district would necessarily be formed in a fairly prosperous, well-settled community whose assets would furnish ample security for the irrigation bonds.

STATE AID FEASIBLE

The plan of state aid in irrigated-land settlement is not a theoretical or impossible one; it is feasible, practical and inevitable. In every country where this system has been adopted it has been proved a practical success, and in no instance has it failed to pay its own way. The plan is based on sound business principles. It does not require the state to donate any money but merely to set aside a permanent revolving fund to be invested, under capable and careful control, in the first essential improvements of raw land and in loans to actual settlers for such improvements, necessary materials and equipment. The money thus invested would have as security a first lien on the land and improvements would be repaid, with a low interest rate, on the long-time amortized plan.

Newcomers are not familiar with good irrigation practice and scientific farming. Oversight and direction along these lines would help them secure the highest possible returns from their land and prevent costly mistakes. By this method the state would have direct control of land settlement, and could exercise some choice in the selection of its settlers by determining the requirements and qualities of character, ability and experience necessary to make them safe risks. The state could prevent land speculation, which is always accompanied by inflated values. High interest and commission rates on loans would be eliminated, and the state would have landowners instead of tenants.

SALE OF PUBLIC LANDS THE SOLUTION

The sale of 4,000,000 acres of public lands in Wyoming, one-half of the proceeds to be used for the construction and maintenance of state highways and one-half to go to a permanent rotating fund for state aid in land settlement, is the solution of the financial problem, Mr. True believes. The state is now planning to undertake the construction of a comprehensive system of highways. These highways will necessarily be built over large areas of public lands, which will greatly enhance their value; yet there is no way to assess a proportionate share of the cost of such construction on these lands. The increased value of the remaining public domain, caused directly by these agencies, he believes, would more than offset the actual value of the lands sold.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Water the Chief Factor in Making Concrete

SIR: In regard to the proportion of water to use in concrete, the discussion of which is now before your readers, the writer thinks one vital point has been overlooked. He believes that the change from dry to wet concrete was largely due to the increase in radical design, thin sections and large proportionate increase of steel.

The construction engineer is given a set of plans and his job is to build them. If, as is not infrequent, the sections are thin and steel is thick, how can the concrete be placed unless it is wet?

The writer has under construction a structure with walls 18 ft. high, 12 in. thick and reinforced both sides with $\frac{5}{8}$ -in. steel on 6-in. centers both ways. The writer cannot conceive how to place the concrete unless it is quite wet.

If concrete is to be placed dry, designers should recognize this fact and show that they recognize it.

C. C. HOWELL,

Assistant Engineer, U. S. Reclamation Service.
Loma, Col.

Combined Curb and Gutter Protects Retaining Wall

SIR: While there is nothing of special merit claimed for the design of the retaining wall here illustrated, it shows how the writer adapted a concrete curb and gutter to the protection of the top of a wall built in San Antonio, Tex. In order to protect the wall from the abrasion and impact which might be expected from traffic at a sharp curve on a city street, a reinforced-concrete combined curb and gutter was built alongside the top of the wall.

By making the curb and gutter independent of the wall it was thought that the blow of a wheel against the curb would be absorbed by the gutter arm of the latter, upon which the wheel is supported. The shock would then, in turn, be so well distributed throughout the underlying earth as to deliver little or no impact to the wall, the foundation of which lies in a creek bed and is of an uncertain nature. The structure has been in service for over a year and has given complete satisfaction.

E. P. ARNESON,

San Antonio, Tex. Civil and Structural Engineer.

Manning vs. Kutter for Measuring Flow of Water

SIR: In reply to R. W. Horne's inquiry printed in the Engineering Record of Nov. 11, 1916, page 600, as to the relative merits of Manning's and Kutter's formulas for the velocity of fluid through pipes and conduits, the position may be summarized as follows:

Both formulas are empirical and designed to fit the facts ascertained by experiment. There is therefore nothing to choose between them, as they must all express the facts fairly closely, and are therefore equally reliable within the range covered by experiment. Inasmuch, however, as there is no rational basis for either, both are equally unreliable outside the range of practical experience and experimental determination.

Possibly Manning's formula is a little more flexible than Kutter's, which is rather complex in form, and perhaps the former would adapt itself better to a wider range of experiments than the latter. It should be borne in mind, however, that our knowledge of the transformation of energy in fluids in motion is extremely limited, and also that the range covered by experiment is far too limited to permit the law of resistance to be definitely ascertained.

E. PARRY,

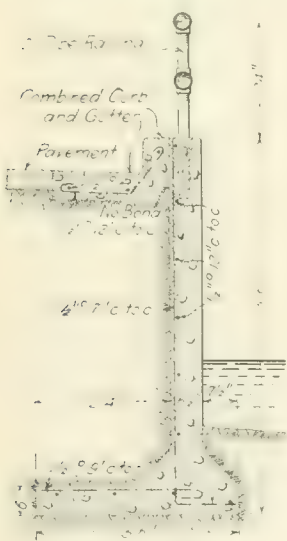
Wellington, N. Z. Public Works Department.

Macon Develops Unique Methods for Finishing Concrete Roads

SIR: In the Engineering Record of Nov. 4, 1916, page 512, there appeared a short note which referred to the methods of construction used on concrete streets in Macon, Ga., and which probably originated here. It may be of interest to other engineers to know something more concerning the methods of construction which have proved so successful in Macon.

In the early spring of 1912 we laid a Portland-cement concrete street pavement, and this pavement without any upkeep is still in almost perfect condition, although it has been exposed to extremely heavy traffic. Since this initial venture we have laid some concrete streets each year, and since the first of July of last year we have laid more than 10 miles of concrete streets ranging from 30 to 46 ft. in width. Practically all of our downtown business alleys are paved with concrete.

After the street is brought to proper grade, thoroughly rolled, all soft or spongy places filled with suitable material and rerolled, the concrete, composed of one part Portland cement, two parts clean, sharp, carefully graded sand, and three parts hard, clean granite, varying in size from $\frac{1}{4}$ to $1\frac{1}{2}$ in., is thoroughly mixed in a batch mixer. The pavement is 6 in. thick at the edge and 8 in. thick at the center. Special attention is given to the consistency of the concrete, which, after having been deposited, is spread to grade by the use



of hose and shovels, and is finished by the use of hollow iron rollers 8 in. in diameter and from 4 to 8 ft. long, with handles long enough to reach a little beyond the center of the street. The rolling is done in a transverse direction, and serves to compact the surface, and at the same time to prevent any tendency to waviness in a longitudinal direction.

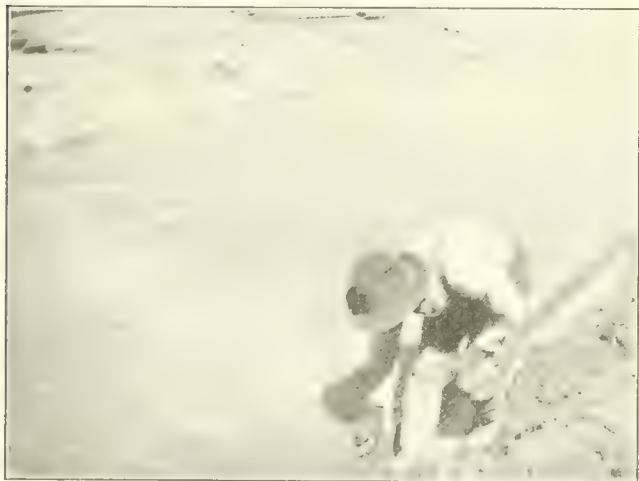
Immediately after the surface is rolled and before it has hardened the final finish is given by dragging an ordinary 1-in. hose over the surface. The resulting



ROLLING COMPACTS SURFACE AND ELIMINATES WAVES

surface is one which is free from waves and bumps, and is probably not excelled by any other material.

The expansion joints consist of one thickness of two-ply tar paper placed, from 25 to 30 ft. apart, at right angles to the curb and extending from the bottom of the pavement to within about $\frac{1}{8}$ in. of the finished surface. Within a few days after placing, the concrete will set sufficiently to cause a fine crack to appear immediately above the tar paper. This crack is thoroughly swept out and painted with Tarvia A heated to at least 250 deg. Fahr., thus completing the joint from the



THE DRAGGING HOSE FURNISHES THE LAST TOUCH

bottom to the top of the concrete. The use of this concealed joint permits the surface to be finished smoothly and avoids the objection so often raised to the use of concrete, that the joints cannot be finished to the true grade. The quality of the concrete at the joint is identical with that of the main body of the street, and the painting of the joints with Tarvia prevents them from raveling under traffic.

About two years ago it became necessary to allow the gas company to make a great number of cuts through

the pavement, the holes ranging from very small ones to some 3 ft. square. After the gas company had repaired its mains, these holes were patched by the city force, and it is now impossible to detect the places patched, except for a slight difference in shade between the old work and the patches. In patching the pavement we were careful to make the sides of the cuts as nearly perpendicular to the street surface as practical. The sides were brushed clean and were well wet, dry cement was sprinkled on the wet sides, and the 1:2:3 mixture of concrete was poured in and finished to the surface of the surrounding pavement.

Concrete is used as the pavement between street-car tracks on several miles of track in Macon. After investigating the matter in other cities and from our own experience we have come to the conclusion that this is by far the best pavement to be used for such construction. Our methods of finishing the pavement between the car tracks may prove of interest. When the concrete is brought to the top of the rail, a little truck mounted on two wooden rollers with flanges the same depth and a little broader than the flanges of the car wheels, and turned to the crown of the finished pavement surface, is rolled along the track, making grooves for the car flanges. Flange grooves constructed in this way provide a very smooth surface over the tracks and show very little tendency to wear even where they are subjected to the heaviest traffic.

Macon, Ga.

J. J. GAILLARD,
City Engineer.

Improving Structural Organizations

SIR: Your editorial in the issue of Feb. 17 on "Improving Structural Organizations" mentions most of the ways of increasing efficiency in such work. One of these methods, "stimulation by bonus payments for all work rapidly done," seems to be deserving of further comment. The following applies to office work, especially drafting. Designers are usually selected men paid at a higher salary and there is less call for a bonus system, especially as it is rather difficult to apply to that line of work.

The purposes of a bonus system are, first, to lower costs by increasing efficiency. This is done by differentiating between the men and rewarding each individual according to the quantity or quality of his work, thus giving him an incentive to greater effort; second, to increase wages without a corresponding loss to the employer. This amounts to giving the employee the benefit of all or part of the saving that he makes. If the stimulating effect of the bonus payments is lacking the system is not a success.

A bonus may be handled in the following ways:

1. A saving in direct expense of labor cost may be made. This is the largest saving for this class of work, and all the saving below standard or estimated time should be given to the man making it.
2. A saving in indirect or overhead expense, which is comparatively small.
3. Attention is called to the fact that there is no saving in machine expense, which saving is largely responsible for the success of bonus systems as applied to shop work.
4. The introduction of other efficiency methods, such

as standardization, planning, scheduling, etc., which a bonus system encourages the men to make use of to the fullest extent, is an indirect method of paying for bonus.

5. The value of a drawing consists of its completeness, accuracy, and the facility with which the product shown may be fabricated or erected. A lowering of the standard by rapid or careless work may result in a loss in shop or field which will more than offset the saving in time in making the drawing.

The writer has recently observed a bonus system involving about 150 draftsmen. The method used is to estimate the cost of the job by estimating the number of sheets and the cost per sheet. The work includes lists of material for the order department, erection drawings, details and checking. All saving below estimated cost is paid to the men as follows: One-half is distributed among the men on the work in proportion to time spent and monthly rate of wages, and one-half is put into a "jack pot," which is distributed to all the men employed at the end of the year. Thus, if a man makes a saving of \$5 on a drawing and is working on a job with nine other men, one-half is divided among the ten men and he gets, say, 25 cents plus 2 cents in the "jack pot." While the company thus pays the men the full \$5, the man who earns it receives only a small share, and the reward is too remote and uncertain to act as an incentive. If the nine other men do not make their drawings below the estimated cost, the first man receives nothing for his saving, as there is no bonus.

The largest percentage received by any of the men for a year's work, counting his share of the "jack pot," was about 10 per cent of his yearly wage, the average 4 per cent, and the minimum 2 per cent. It is a well-known fact in factory work that if the bonus offered is not close to 20 per cent for such of the men as can do the work in the estimated or standard time, few of them will make the effort necessary to earn it, and the bonus system fails of its purpose. Yet at the office cited it occasionally happens that a squad boss receives a bonus of \$100 or more for three or four months' work, which is about 15 per cent, and under the present system means an excess of estimate over actual cost of 30 per cent. This usually leads to a cut in future estimates on similar work, especially if the estimator is censured for being too liberal. If the estimate is too low, the men know that they cannot make a bonus and the stimulating effect is entirely lacking. When a job is estimated as a whole, one man, as a checker, may "kill" the bonus by loafing on the job and using up all the time saved by the others.

Those responsible for the quantity of work done, as the squad boss, should share in the time saved by proper planning and rapid work. Those responsible for the quality of the drawings—the checkers and the engineer-in-charge—should not share in the time saved by the rapid work of the detailers, as there may be a slight tendency to pass things that should be corrected.

The following suggestions may be of use to those interested in a bonus system:

1. Give a guaranteed wage which is as great as if no bonus were offered.

2. In making an estimate of a job, divide it into several component parts—by function—as ordering, detailing, checking, supervising, etc.—by sheet, or by any

other method that suggests itself. The purpose is to make the reward of each man or small group of men as immediate as possible not only in point of time, but also in point of application. Give what each man earns to him and not to some one else. The number of subdivisions should increase with the number of men on the job. A one-man job need not be divided.

3. Estimate accurately the cost of each part. The difficulty of doing this, even at considerable expense, will readily be appreciated, especially as the average time for making a drawing often drops when a good bonus system is installed.

4. Endeavor to give each job a bonus, say at least 10 per cent of the estimated cost, for rapid, conscientious work. Considerable dissatisfaction is often expressed by men who never get a chance to make a bonus.

5. Do not cut estimates if bonuses run higher than expected. Remember that there is always a saving if estimates run lower than before, whether wages are paid under the new system as bonus or for straight time. It is better to set an upper limit of 30 per cent or more if bonuses are too high, but that may never be necessary if estimates are carefully made.

6. The principal benefit to be derived from a bonus system is increased satisfaction, loyalty, and efficiency, on the part of employees, rather than any appreciable saving in cost to the employer.

7. A bonus system may be made an effective instrument, but it will never reach its fullest possibilities unless handled with a liberality and breadth of view which is rather uncommon at the present time.

Pittsburgh.

PARKER R. WHITNEY.

Qualifications of an Engineer

SIR: From time to time, during the last two or three years, I have read in the Engineering Record abstracts of speeches, committee reports, letters, etc., concerning the qualities in an engineer which are essential to his success. My recollection is that in every case technical knowledge was the least important of the factors enumerated.

From the point of view of a senior in a school of civil engineering, there seems to be a lack of consistency between what engineers say in theoretical discussions and what they do in actual practice. Now, I am a youngster, nineteen years old. Most of these years have been spent in the public schools and in college, so that the charge of inconsistency which I am making may be the result of my ignorance. I myself am inclined to think so, and the only reason I am writing is that a reply to this letter may appear in the Engineering Record and set me right. Let me tell you why I think that employers say one thing and do another. I could give instances of other men, but my own experience this summer is perhaps more convincing, because it is personal. I went to see a number of engineers about a job for the summer, and my lack of engineering experience put me out of the running every time. I went to a firm of nation-wide activity, where, I was told, there was a vacancy in the bookkeeper's staff. I told the head bookkeeper that I knew nothing about bookkeeping. Still he said he would try me. Two months later I received a call from the head of the eastern division to take a position in his office. Now, I don't tell you this

to prove to you what a bright little boy I am, not at all. The point I am trying to make is this: If, as I have read repeatedly, and as has been told me by my professors, it is true that what counts in an engineer is not so much what he knows about stresses and trusses and detailing, and so on, but his character, his adaptability, his capacity for hard work—I say, if this is true, why is it, then, that when I come to apply for a job I am not examined for the purpose of judging of my character, of my adaptability, or of my capacity for hard work (by actual test)? No, employers don't ask about these things, which engineers say are the most important things. What they ask me is: "How much do you know?" For to ask how much previous experience you have is to ask what you know.

To be sure, it is much easier to judge an applicant

rience in construction work call for bids and then reject them, placing reliance on some scheme for executing the work for less than the contractors' price. This may be a wise course in some cases, but it should always be borne in mind that the bidder assumes the risks, and adequate allowance for this element must be made.

The loss of the Milwaukee is not cited as a case of inexperience in handling the work but rather as illustrating insufficient allowance for risk. A \$4,000,000 cruiser was lost in a vain effort to accomplish work on which five contractors had made bids ranging from \$60,000 down to \$18,000.

The situation in this case developed as follows: The submarine H-3 recently went ashore in the fog near Eureka, and after a number of unsuccessful attempts



FOUR MILLION DOLLAR CRUISER LOST WHILE ATTEMPTING \$60,000 SALVAGE JOB

by his experience than by such intangible things as character, adaptability, and the rest of the qualities mentioned by writers and speakers on the subject. That is indeed a problem. The only solution that presents itself to my mind is to give a man a chance to reveal the necessary qualifications, or his lack of them, a solution which men who know more than I do about actual conditions may consider impracticable.

As I say, the views I have expressed may be wrong because of my ignorance, but I want to learn. Perhaps someone will reply and clear the matter up for me.

HARRY BERLIN,

New York City. Student, New York University.

The Contractor's Risk

SIR: The loss of the first-class protected cruiser Milwaukee, which went ashore on the California coast near Eureka on Jan. 13, affords a striking illustration of the allowance that must be made for the risk element in considering bids on engineering work. More and more frequently nowadays is heard the announcement, "All bids rejected; work will be done on the day-labor basis." Often municipalities without extensive expe-

to get it off into deep water bids were called for on the work of salvaging the submarine. Five offers were received, including a plan to haul the submarine across the sand bar into Humboldt Bay, which involved practically no risk. It was decided, however, that another effort would be made by navy officials to float the boat, using more powerful vessels than had previously been employed.

Accordingly, the cruiser Milwaukee and the monitor Cheyenne, accompanied by the navy tug Iroquois, were dispatched to the scene. On Jan. 13 they got a line aboard the submarine and attempted to pull it through the surf. The Milwaukee was nearest to the submarine, the other two boats, farther off shore, having lines to the Milwaukee. Pulling against a dead weight in the rough sea caused the line between the Cheyenne and the Milwaukee to part. After this the drag of the heavy cable, which was about 2 in. in diameter and almost half a mile long, was more than the Milwaukee and the Iroquois could withstand and both vessels, realizing that they were being drawn inshore, attempted to slip the cables.

The Iroquois succeeded in getting free, but the Milwaukee, while endeavoring to cut the heavy cable with

cold chisels, was drawn into the breakers and driven broadside on the beach, where it was exposed to a destructive pounding by the waves.

An inspection of the cruiser below decks shortly after indicated that the stanchions had begun to give way and that there was practically no hope of refloating the vessel. Plans were later made for taking off such equipment as could be removed while the vessel lay in such an unfavorable position. It is safe to say, however, that the loss will amount to several million dollars; and only skillful work prevented loss of life in rescuing the 435 men aboard the unfortunate cruiser.

San Francisco.

K. T. ROBERTS.

Fits Planimeter With Tongue, Making the Tracer Point Visible

SIR: I am inclosing a photograph and a sketch of two devices constructed by the writer which have saved considerable time and annoyance.

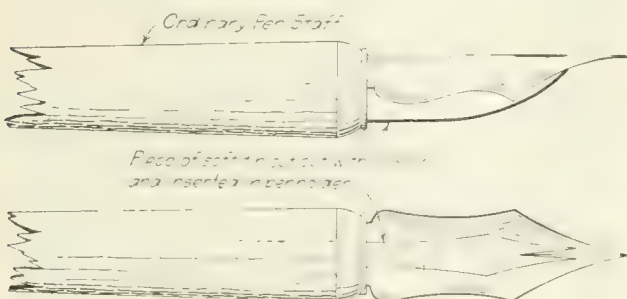
The photograph shows a small planimeter as revised. When bought, the tracer point was attached to the arm by means of the tongue shown just below the instrument proper. This tongue curved toward the operator, so that the point was hidden three-fourths of the time, unless the operator leaned his head over in an uncomfortable position. The new tongue was made from a piece of brass "lead" or "rule" used in a printing office. It was sawed to approximate shape and filed smooth. Holes were drilled large enough to allow sufficient play for adjusting, and the tongue was then inserted in place of the old one.

By actual test the operator was able to do more than 25 per cent more work when using the instrument as revised, and claimed to be less tired at night.

The sketch shows a piece of tin cut into proper shape and inserted into a lettering penholder to make a "foun-



NEW PLANIMETER TONGUE
CURVES FROM OPERATOR



PIECE OF SOFT TIN CONVERTS ORDINARY PEN INTO
"FOUNTAIN" PEN

tain" pen of the ordinary point. It is so simple that I am almost ashamed to call attention to it, but its convenience and cheapness are worthy a trial. This "fountain" pen may be filled with ink above the eye or slot in the pen without feeding too freely. The ink retainer is easily removed for cleaning.

R. T. BROWN,

Engineer, Board of Road Commissioners.

Davidson County, Lexington, N. C.

Building Levees with Bucket Dredge

SIR: The suggestion made by Arthur M. Shaw in the article on page 730 of the Engineering Record of Dec. 16, 1916, regarding the employment of grab-bucket dredges for making levees along the Mississippi River reminds me that this method was used by us more than 50 years ago in building dikes along the canal from the North Sea to Amsterdam, Holland. If my memory does not mislead me, equipment of this type was especially designed for the work by a Mr. Burgges, one of the employees of Merfer, Treeman & Company, the contractors for this canal. It was also on this work that concrete was used to a large extent for the first time since the introduction of Portland cement for constructing sea walls. These walls extended for a long distance at right angles with the beach into the North Sea, forming the entrance to the canal.

Guatemala.

JUAN I. DE JONGH,

Consulting Engineer.

[The Engineering Record understands that Mr. Shaw referred to this method as having been in general use, but as being barred on the construction of levees for the United States Government by clauses in the specifications adopted by the government as standard for this work.—EDITOR.]

Quartz-Gravel Concrete and Fires

SIR: Your editorial comment with respect to Professor Woolson's paper on "The Responsibility of Quartz for Disruptions in Concrete Subjected to Fire," page 127 of the issue of Jan. 27, draws attention to a very interesting subject.

At the time of the fire in the Edison factory at Orange, N. J., the writer made an examination by permission of Mr. Edison and found that not only were some of the larger aggregates injured by fire, but further that some of the smaller sand grains showed what was apparently expansive disruption. Some photographs of these features were exhibited in the discussion of the Edison fire report at the American Concrete Institute meeting at Chicago in 1915. Perhaps as illuminating and significant an observation on this subject as could have been made was that of Mr. Edison on reviewing the findings of this examination: "I don't know whether the sand grains have cracked or not, but I know there is no rock that will not spall under heat." Considering quartz gravel and sand grains as but particles of rock of smaller size, is it not reasonable to expect the disruptions which Professor Woolson has noted?

NATHAN C. JOHNSON,

New York.

Consulting Concrete Engineer.

Greatest Coal Production in 1916

Coal-production records were smashed in 1916, when the output was about 597,500,000 tons, compared with the previous high record, established in 1913, of 570,000,000 tons. The quantity of bituminous coal mined was 509,000,000 tons, an increase over 1915 of 66,500,000 tons, or 15 per cent, according to estimates by C. E. Leshner, of the U. S. Geological Survey. The quantity of Pennsylvania anthracite was about 83,312,000 net tons, a decrease of 600,000 tons.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Sheet-Pile Outriggers Bolted to Crane for Moving with Heavy Loads

By H. W. STREULI
Schenectady, N. Y.

SHEET-PILE outriggers bolted to the underframe of a locomotive crane, as shown in the photograph, were used in constructing a section of the Passaic Valley sewer to enable the crane to move along the track without delay in handling material excavated with the grab bucket, and still be able to handle the loaded bucket safely at maximum radius.

The outriggers were installed after the crane had been overturned, involving a loss of \$500 and three days' working time. In hoisting a 1-yd. loaded bucket the operator made an error in his levers, turning the bucket loose. As there was no one under it, he should have allowed it to drop, but attempted to catch it. The momentum of the bucket at the maximum radius of the boom turned the crane over into the hole.

The rail clamps supplied by the manufacturers of cranes are not of much use in a situation like that in which this crane was working, where the track is often temporary, with light rails, poor ties and no ballast. Moreover, in order to dump the material it was necessary to move the crane a short distance from digging position, with each load under overhead

wires. To stop to fasten and take off these clamps with every load, and at the same time do efficient work with the crane, was out of the question.

The ties under the track were therefore replaced at 8-ft. intervals with 10 x 10-in. timbers 18 ft. long, thoroughly ballasted with crushed stone and supported at the ends next the excavation on blocking from the 40-ft. steel sheeting which lined the trench. Heavy rails were spiked to the ends of these timbers parallel

to the track and 5 ft. outside the running rails on each side. Two 16-ft. pieces of steel sheet piling 13 in. wide and weighing 40 lb. per foot were bolted to the crane truck on each side with eight 1-in. bolts apiece. These sections projected beyond the guard rails on each side, as shown in the photograph. They cleared both the running and the guard rails by about $\frac{1}{4}$ in. Being extra pieces already on hand, they were applied without difficulty and at little cost, compared with procuring channels or I-beams for the same purpose.

The method, while insuring the crane against turning over under any conditions, allowed free movement along the track and caused no delays for block-

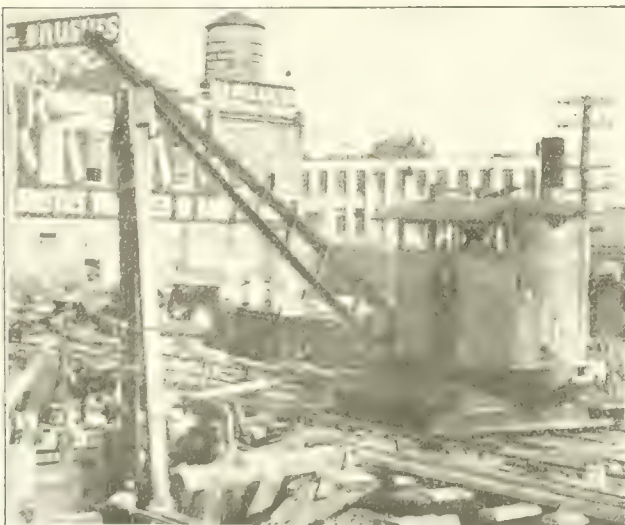
ing or otherwise anchoring the crane when necessary to operate it at maximum radius.

IF A CONTRACTOR could hide his job under a bushel, we'd understand why some of you don't "let your light so shine," etc.

But it's perfectly obvious that it can't be done. It would take a three-ring circus tent to cover even an ordinary job. And even then, human nature is so curious you'd have to arm a gang with stakes to keep people from sneaking under the flaps.

So as long as everyone is going to see your stunt anyway, be a sport and give it a place in the parade in

HINTS FOR THE CONTRACTOR



SHEET-PILE OUTRIGGERS BOLTED TO CRANE TRUCK

The Elusive Cement Sack

THE VARIED CAREERS pursued by those cement sacks that are numbered among the missing when the shipments of return bags to the mill are tagged have been epitomized in a ditty entitled "One More Sack Is Gone," put forth by the Universal Portland Cement Company, and sung to the tune of "John Brown's Body" at select gatherings of the cement industry:

The Polak needs an apron to protect his dainty waist;
He beats it to the pile where all the empty sacks are placed,

Picks out the best that he can find and then skidoos in haste—

And one more sack is gone.

Chorus

Some one's going to lose the money,
Some one's going to lose the money,
Some one's going to lose the money,
For one more sack is gone. \

The Dago has to work on ground that is a trifle wet,
But will he get pneumonia? No! he will not—you
can bet!

He wraps his feet in empty sacks—they never stopped
him yet—

And one more sack is gone.

The Hunkie wants a handy bag for carrying his tools;
The sacks are lying all around—there are not any rules
To keep the men from stealing them—they teach it in
the schools—

And one more sack is gone.

The Ginny slips, and though, by luck, he isn't badly
hurt,

He sees upon his lingerie a tear and maybe dirt.

He steals a sack and takes it home to make another
shirt,

And one more sack is gone.

Pat Levee-Slope Concrete Smooth with Plank Before Finishing

By ALBERT S. FRY

Memphis, Tenn.

IN PLACING concrete on the slopes of the Gayoso Bayou in Memphis the Koehler Brothers, Fowler Construction Company found it necessary to mix the concrete very dry in order to make it stand on the 1 to 1 slope. After raking the concrete down to the required 6-in. thickness the surface was quite rough and had a sort of mealy appearance.

To bring this surface to a finish that could be troweled, a long plank laid flat on the slope and raised and dropped with a wire by a negro laborer, who kept his foot on its lower end to steady it, was used. The wire was attached about the middle of the plank. The board was sufficiently heavy when dropped through the short distance it was raised by the wire to pat the concrete down into a fairly smooth surface.

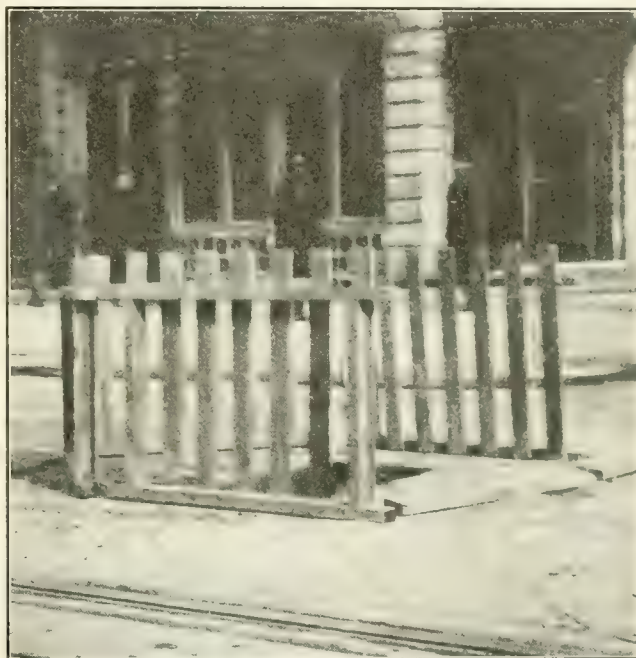


PLANK FLAPPED UP AND DOWN WITH A WIRE USED TO
SMOOTH CONCRETE

The final finish was given the slope by two laborers working from a ladder laid on it. A thin mortar was placed on the surface already patted down and then floated to a smooth finish. The ladder was held in position and prevented from sinking into the concrete to any extent by short pointed projections on the under side at the top end.

Jointed Fence Guards Holes in Street Decking

HINGED FENCES like that shown in the photograph may be spread out to cut off half the roadway or contracted to guard a small opening without blocking more than a few feet of the roadway. When folded together, they occupy very little space and can readily be



JOINTED FENCE GUARDS HOLES OF ANY SIZE

stored or handled. Besides being a great deal more convenient and adaptable than the horses commonly used for the same purpose, these picket fences, painted a bright red, are much more visible and therefore less apt to be run through accidentally. Their neat appearance and the fact that they do not block any more of the street or sidewalk than is absolutely necessary also make them much less objectionable to the public than the usual type of obstruction.

The sections of these fences, which have been built and are being used on a section of the new Broadway subway in New York City by the Holbrook, Cabot & Rollins Corporation, consist of a top and a bottom piece to which the pickets are nailed, with a post at each end, just outside which is a long bolt extending through both pieces. The sections are connected to make a fence of any desired length by light plates at the top and bottom, free to turn around, a bolt through each end securing them to the fence. This gives a double hinge at each joint and makes it possible to fold the fence flat against itself. Most of those used on this section are made up by hinging four sections together.

Baby Hoists Turn Bullwheel of Large Derrick When Swinger Breaks

By H. L. HICKS
Great Neck, N. Y.

TWO LITTLE tugger portable air hoists were substituted recently for the regular swinging gear used to operate a large quarry derrick in Vermont while the regular engine was being repaired. As the derrick—



TWO SMALL HOISTS MAKE ONE SWINGING GEAR

the largest of those in use—was important to continuous operation, the quarry was practically tied up by an accident to its swinger. The superintendent, however, quickly improvised a new swinging gear by bolting the two "little tuggers" side by side to 2-in. planks, which in turn were changed to two large blocks of granite, as shown in the photograph. The lines from the hoists were led to opposite sides of the bullwheel, one being used to turn the derrick in one direction and the other to swing it back. This improvised arrangement kept the derrick in operation more than a week while the regular swinging engine was being repaired. In ordinary service one of these little hoists is used to overhaul

the heavy cable from one of the derricks across the quarry pit, as described in the Engineering Record of June 24, 1916, page 843, while the other is used in lowering steels and light loads into the pits.

The rig described was used in the Montpelier (Vt.) quarry of the Wetmore & Morse Granite Company.

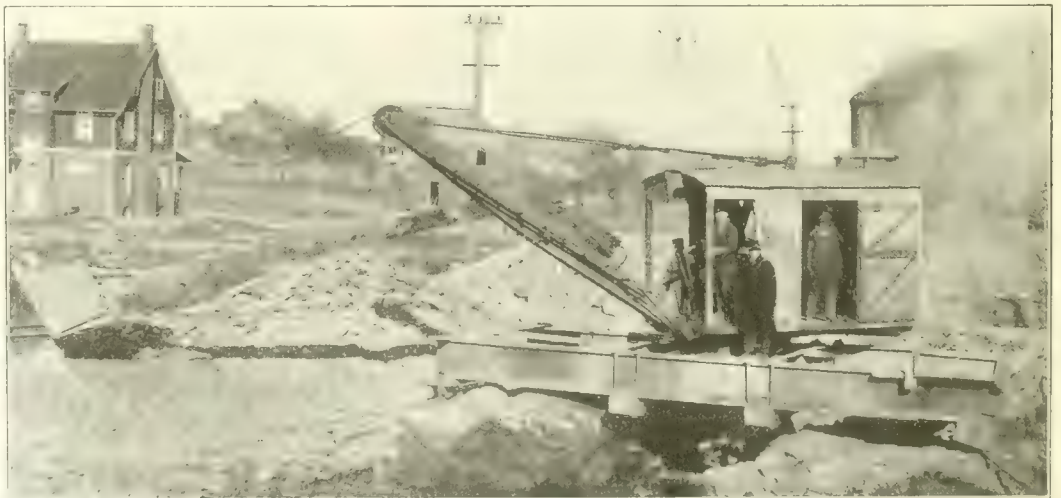
Snow and Salt Keep Ice from Freezing Around Bridge Falsework

By LOUIS G. ARNOLD
Assistant Superintendent, Wissota Dam,
Chippewa Falls, Wis.

DURING the removal of the highway bridge over the Chippewa River to permit the placing in service of a new reservoir of the Wisconsin-Minnesota Light & Power Company, the lake surface, covered with a thick layer of ice, was continuously rising. If this ice had been allowed to freeze to the falsework used in the removal of the bridge, a serious accident might have followed. At first a great deal of time was spent in cutting the ice away from the falsework, but later it was found that the same result could be accomplished by filling the water around the piles with soft snow sprinkled with barrel salt. In this way the labor cost of cutting the ice from the piles was practically eliminated.

Steel Frame Gives Wide-Span Support for Steam Shovel Over Trench

TO MINIMIZE caving where a wide, deep trench is being built, Miller Brothers, contractors, of Youngstown, Ohio, mounted their Erie steam shovel on a bridge of steel I-beams instead of the usual timber platform. With the latter, 25 ft. is about the maximum length, but the machine shown in the pictures rests on I-beams 35 ft. long. The shovel is secured to wooden timbers suspended below the I-beams by U-bolts. By this arrangement the center of gravity of the shovel is lowered and tipping obviated. The machine is moved forward over rails laid at the very ends of the frame so as to concentrate the load as far from the edge of the trench as possible.



FRAME OF LONG I-BEAMS SUPPORTS STEAM SHOVEL SAFELY IN EXCAVATING WIDE TRENCH

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

James H. McGraw, Technical Publisher

What the New President of the McGraw-Hill Publishing Company, Inc., Has Contributed to the Progress of American Technical Journalism

Thirty-three years ago a young man, his fingers fidgeting with the buttons on his coat, faced an audience in the Normal School of a little up-state town in New York and delivered the valedictory address for the graduating class. Last week the same man faced another audience—the 257 employees of the great technical publishing organization which his genius had created and developed into an instrument of far-reaching power in the engineering field. All the indecision of his school-boy oratory was gone. This time he had a real message to tell—a message which chronicled the birth of the world's largest enterprise devoted to the production of technical and business papers. By consolidating his own business interests with others of similar magnitude, James H. McGraw, president of the newly formed McGraw-Hill Publishing Company, Inc., which will control ten engineering periodicals, each the leader in its field, becomes the dominating influence in American technical journalism.

Will Control Ten Papers

To engineers the commanding position of the new organization can best be indicated by an enumeration of the papers which will be issued under the McGraw-Hill management. There are, first, the Engineering Record and Engineering News, both enjoying an international reputation, which will be consolidated into a new weekly journal—the Engineering News-Record. The consolidated paper, following the policies of its two constituents, will be devoted to the field of civil engineering and construction. But all of the other major engineering fields—electrical, mechanical, mining and chemical—will be served by such influential mediums as the Electrical World, Electric Railway Journal, Electrical Merchandising, Metallurgical and Chemical Engineering, The Contractor,

American Machinist, Power, Coal Age and the Engineering and Mining Journal.

Into the historical texture of this great publishing project, started more than a score of years ago, the life of James H. McGraw is intimately interwoven—in fact, the business is the physical embodiment of his ideals and thinking. Born in Panama, Chautauqua County, New York, in 1860, Mr. McGraw spent his early days on his father's farm, attended the local schools and was graduated in 1884 from the Fredonia Normal School as valedictorian of his class. Even as a young man, his qualities of leadership asserted themselves. As president of his class and leader of the debating society, he soon became an important factor in the life of the school.

For a few years after graduation he taught school in several towns in western New York, but his ambition for bigger things made him dissatisfied with this work. He resigned and came to New York City, where, as representative of the American Railway Publishing Company, he gained a foothold on the lowest rung of the publishing ladder.

Enters the Publishing Business

For a while Mr. McGraw served as Philadelphia representative of the American Railway Publishing Company, which controlled three papers, the Street Railway Journal, Power and the American Journal of Railway Appliances. His early work in the publishing business was in the circulation and advertising departments. Here he developed that close acquaintance with the field which was to become such a valuable asset in his later work.

These were the days of the horsecar, and when electric traction was first proposed Mr. McGraw was quick to see its possibilities. This was his opportunity; even in early life he was a man of broad vision and enthusiasm. It is characteristic of his power that in 1888, only a couple of years after he had entered the business to which his life was to be devoted, he became the sole owner and publisher of the Street Railway Journal.

His acquisition of this property merely started him upon his career as a publisher. The rapid development of electric traction and the consequent obsolescence of the horse car placed him in a strategic position. He had a great influence in the field, and he used it always for the upbuilding of the industry. In fact, it is generally recognized that no one has done so much for the electric railway business as he. He worked not only through his paper, which later was renamed the Electric Rail-

President of the Newly Formed McGraw-Hill Publishing Company, Inc., Controlling Ten Leading Technical Journals



© Underwood & Lothrop

JAMES H. MCGRAW

way Journal, but also through the American Electric Railway Association, in whose work he has taken an active part.

With the growth of electric traction, other developments occurred. Great industries were springing up for the manufacture of electric equipment of all sorts. To so keen an observer as Mr. McGraw, these beginnings of an electrical industry, which was soon to become colossal in its proportions, were significant. Again his vision pictured an immense field for a technical journal. With this conception in mind, he purchased in 1896 *Electrical Industries*, which he renamed the *American Electrician*, a monthly periodical devoted to electrical and mechanical engineering. Three years later, in 1899, he acquired the two leading electrical journals—the *Electrical World* and the *Electrical Engineer*, both of New York. These, with the *American Electrician*, were consolidated into one publication, the *Electrical World*, now the leading journal of the electrical industry.

Engineering Record Purchased

To control these properties the McGraw Publishing Company was incorporated in 1899, with Mr. McGraw as president and controlling stockholder. Already a factor in the street railway and electrical fields, he struck out into new territory in 1902, when he bought the *Engineering Record*, a weekly journal devoted to general engineering, established in 1877 as the *Plumber and Sanitary Engineer*. Backed by his thorough knowledge of the technical publishing business and his rapidly growing resources, Mr. McGraw soon made the *Engineering Record* a journal of national influence in the civil engineering and contracting field.

At about the same time as the *Engineering Record's* purchase was effected, Mr. McGraw started in Philadelphia a new publication known as *Electrochemical Industry*, published monthly. This paper was later removed to the New York office of the McGraw company, and beginning with January, 1905, the scope and name of the paper were enlarged. The journal became *Electrochemical and Metallurgical Industry*. In 1910 the name was again changed to *Metallurgical and Chemical Engineering*, and beginning September, 1915, the paper was issued semimonthly, instead of monthly.

A shrewd observer of developments in the electrical field, Mr. McGraw saw, last year, the need of two papers instead of one—the *Electrical World*. Two groups of readers had developed—one, the technically trained electrical engineer, and the other, the electrical contractor and the merchant engaged in the sale of the various electrical devices placed upon the market for use in the home. Mr. McGraw decided to maintain the *Electrical World* as the technical paper of the electrical industry and to issue another publication devoted exclusively to the merchandising of electrical equipment. In 1916, therefore, he purchased *Electrical Merchandise* and *Selling Elec-*

tricity, and changed the name to *Electrical Merchandising*, the first issue under the new name and management appearing July 15, 1916.

During the same year a somewhat similar problem arose in the field of the *Engineering Record*. It was felt that the *Engineering Record*, as a national publication, could not well serve all elements in the contracting field. It was decided, therefore, to issue a new paper, and Mr. McGraw accordingly bought *The Contractor* and *The Contractor's Review*, both of Chicago, and merged them into one journal, *The Contractor*. This paper is published fortnightly, and the first issue under the new management appeared Jan. 15, 1917.

Constructs His Own Building

As the properties of the McGraw Publishing Company developed, it became apparent that the quarters formerly occupied at 114 Liberty Street, New York City, would be inadequate. Mr. McGraw decided to have a building of his own, and in 1906 began the erection of the eleven-story reinforced concrete structure at 239 West 39th Street, which has been the home of the *Engineering Record* and his other publications. It is significant of the growth of the business that only a few years after the new building was finished, a second one of the same size was constructed as an addition on the west side of the original structure. With the consolidation of the McGraw and the Hill publishing companies the organization will have available the present McGraw building on 39th Street and the imposing structure erected by John A. Hill for his papers, at 10th Avenue and 36th Street.

So much for the business achievements of James H. McGraw. He is a man who has carved out his own career—a man in whom vision and courage are linked with unusual qualities of leadership and organization. Never an editor himself, he has, nevertheless, always held rigidly to the policy that the success of a technical journal must be built around an editorial staff which knows no instructions beyond those of giving the reader what is best, irrespective of any other consideration. He is essentially a man of action, a doer of big things. His mind is unerring in its grasp of essentials. He is never hasty in arriving at decisions, but adheres to them persistently when once formed. He is a worker of enormous capacity and has a memory which is almost uncanny in its retentiveness. Time and again he has predicted the results of elaborate investigations by his associates, involving pages of statistics, with an accuracy that is startling. These predictions, however, were not guesses, but matured, even if quickly formed, judgments based on a most intimate knowledge of the publishing business.

The new organization, publishing the dominant papers in all the great engineering fields, presents a still wider scope for his extraordinary abilities.

Engineers of Southwest to Form Society

A society of engineers of the Southwest is to be formed at a meeting called for March 8, 9 and 10 at El Paso, Tex., at the instigation of the faculty of the school of engineering of the State College of Agriculture. Arizona, Texas and New Mexico men are to be included in the new society. A preliminary meeting at the El Paso Chamber of Commerce, called by Dean A. F. Barnes, Dec. 27, started the plans for the new society which is to be launched this month. The constitution committee has practically completed its work, and the following are extracts from the proposed document:

"The object shall be the professional improvement of its members; the encouragement of social intercourse among engineers; the advancement of engineering knowledge, education and practice, and the maintenance of a high professional standard among its members.

"Second, it was thought best to provide for three classes of membership—namely, the full member, who is an engineer not less than 27 years of age and who has been in active practice in his profession for at least six years; the associate or junior member, who shall not be less than 18 or more than 30 years of age and who shall be actively practising or a student or graduate of a recognized technical school; the affiliated, who shall be a person interested in the objects of the society and who shall by practical experience qualify to co-operate with engineers, but who is not a professional engineer.

"Third, the constitution provides for an initiation fee of \$5 for members, for associated \$3 and for affiliated \$2. The annual dues for members are \$3 and for associates and affiliated \$2. Fourth, the constitution provides for semi-annual conventions, the first on the third Wednesday in October, to be held in El Paso, Tex., and the second to be held at such time and place as the board of directors may determine."

Applications for charter membership will be received up to the time of the convention by the following, who comprise the temporary membership committee: J. F. Woodyards, Jr., Box 1117, El Paso, Tex.; Dean G. M. Butler, Tucson, Ariz.; S. O. Andros, Albuquerque, N. M., and Dean A. F. Barnes, State College, New Mexico.

Holds First Washington Meeting

The first Washington meeting of the Western Society of Engineers was held recently. It was the forerunner of future meetings at which the Washington Award, established by John W. Alvord, is to be presented. Five short papers were presented on engineering work in Washington's time: "Surveying," by Ernest McCullough; "Iron and Steel Industry," by J. N. Hatch; "Hydraulic Sanitary and Municipal Engineering," by C. B. Burdick; "Roads and Pavements," by A. N. Johnson, and "Shipbuilding," by John G. Kreer.

The Hill Publishing Company and Its Founder

Organization Which Consolidates with McGraw Company Controls Five Prominent Engineering Papers

The history of the development of the Hill Publishing Company, like that of the McGraw Publishing Company, Inc., with which it has become consolidated, is built largely around the efforts of one man. The late John Alexander Hill, founder of the house which bore his name, began his publishing career by the acquisition of *Locomotive Engineering*, a paper on whose editorial staff, a few years before, he had been given a position as editor. With Mr. Hill at its head, the journal soon became successful. Hardly had it become firmly established when Mr. Hill sold it and purchased the *American Machinist*, laying the foundation for one of the largest enterprises in the field of technical publication ever established.

Since its formation in 1902, the Hill Publishing Company has reached a position in the front rank of technical journalism. It had its beginning in the consolidation of the *American Machinist Press*, publisher of the weekly *American Machinist*, and the *Power Publishing Company*, publisher of the monthly *Power*. In 1905, the weekly *Engineering and Mining Journal* was purchased. In 1908 the semi-monthly paper, *The Engineer*, of Chicago, was consolidated with *Power* and the latter paper was made a weekly. In 1911 *Engineering News* was purchased. A new weekly paper, *Coal Age*, was started in October, 1911, its field being coal mining and coke manufacture. Four years later the *Colliery Engineer*, published in Scranton, was bought and consolidated with *Coal Age*. The *Mining and Engineering World*, published in Chicago, was acquired in December, 1916, and consolidated with the *Engineering and Mining Journal*.

Mr. Hill's enterprises proved so fortunate and expanded so rapidly that it became necessary to provide ample quarters for them, and in 1914 he completed the large building at 10th Avenue and 36th Street, New York City, where his five papers were edited and printed. To this building Mr. Hill devoted the last years of his life, planning at every point to suit the convenience and economy of the printing and publishing business, and at the same time providing for the safety, comfort and health of the army of workers which he employed.

After Mr. Hill's death, Arthur J. Baldwin was appointed to the presidency of the Hill Publishing Company. Mr. Baldwin, the new vice-president and treasurer of the McGraw-Hill Publishing Company, Inc., is a lawyer by profession and for many years was closely associated with Mr. Hill.

For the ten years before becoming the administrative head of the Hill Publishing Company, Mr. Baldwin's attention had been directed almost entirely to business problems. Among

the offices he held were those of treasurer of the Rogers Silver Plate Company; treasurer of the Borough Development Company, which held a contract to remove ashes from Brooklyn; treasurer of the Boston Development & Sanitary Company, which handled all the garbage and ashes for the city of

New Vice-President and Treasurer of the McGraw-Hill Publishing Company, Inc.



ARTHUR J. BALDWIN

Boston; vice-president of the Automatic Fire Protection Company, and secretary of the Mississippi Wire Glass Company.

For many years Mr. Baldwin had been Mr. Hill's business adviser and confidant. This position of intimacy between the two men enabled Mr. Baldwin to enter upon his work as president of the Hill organization with a thorough grasp of its details and policies.

Road Men Urge Interstate Route

Resolutions urging upon the legislatures of Idaho, Montana and Washington the desirability of an interstate highway route by way of Missoula, Lola Pass and Lewiston, Idaho, were adopted by the Interstate Highway Association at its recent convention in Pasco, Wash. Additional resolutions urged upon the legislatures the necessity for generous appropriations for sparsely populated sections, provisions for road maintenance, a uniform system of highway signs established by law, a combination of northwest states for advertising natural resources and scenic advantages, and the organization of committees under the auspices of the association for the beautifying of highways by planting trees and shrubs. Lewiston, Idaho, was selected as the place for the annual meeting next November.

Garage Roof Collapses 79 Days After Concreting

Long Drying in Freezing Weather Before Cement Could Set Precedes Accident at Omaha

By A. C. AREND
Omaha, Neb.

The fatal collapse on Feb. 27 of a reinforced concrete garage roof in Omaha, which was poured 79 days before, on Dec. 10, is probably traceable to the drying out of the concrete during this long interval when the temperature was close to or below freezing and during which there is no evidence of the concrete having had an adequate opportunity to set. The accident occurred two days after a sudden rise in temperature and about the time the forms under the collapsed portion had been removed and the temperature inside the building raised for the operation of placing floor finish. The building, that of the Sample-Hart Company, is a two-story brick and reinforced concrete structure, intended for an automobile sales and service station. The contractors for the building, the Home Builders, Inc., erected the forms and placed the concrete.

Eyewitness to Accident

About four o'clock in the afternoon of Feb. 27, 1917, nine contiguous panels collapsed, killing one workman and injuring two others, one very seriously. The superintendent has stated that a workman had come to him with the statement that a piece of concrete had fallen from a beam and had hit him on



TOP OF COLUMN SEEN TO FAIL FIRST

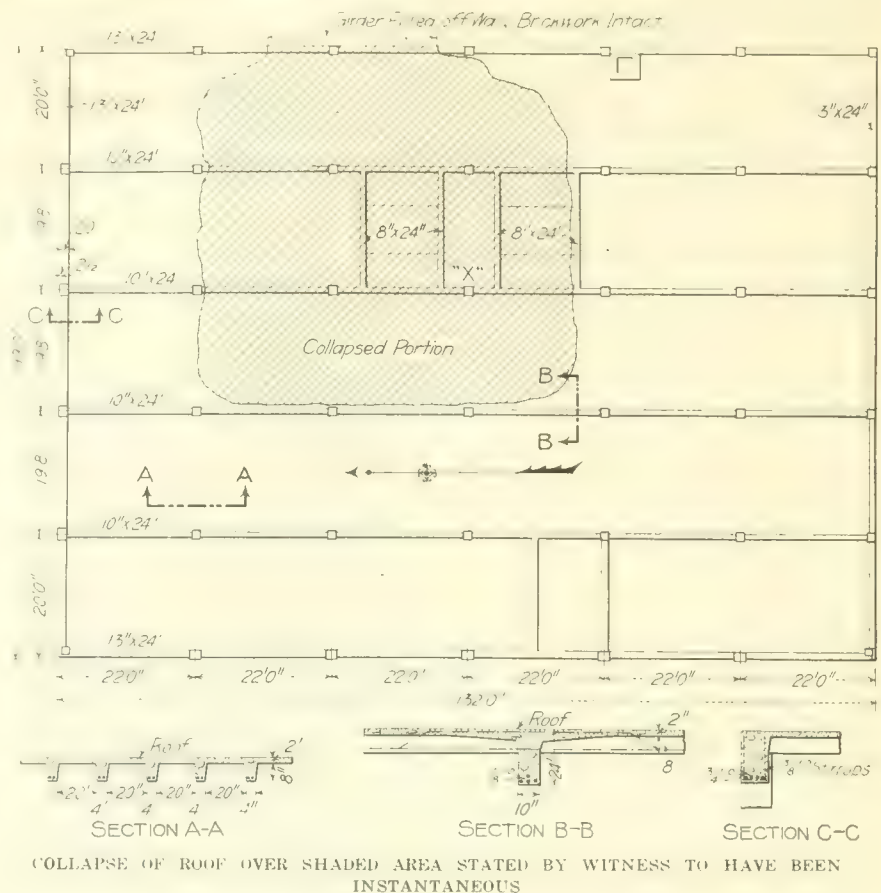
the shoulder. Turning from what he was doing, he started to the portion of the building where the concrete had fallen, and as he was looking at the column top marked X on the plan, from near which the concrete had fallen, he saw it begin to crush and fall away. Suddenly the whole thing came crashing down, leaving conditions much as shown in the photograph. The collapse occurred so quickly that he did not have time to issue a warning cry.

Temperature Near Freezing

This portion of the roof was poured on Sunday, Dec. 10, 1916, without the knowledge or consent of the city building department. The temperature was practically below the freezing point all day, and toward evening it became cloudy and colder. Apparently there was no attempt made to heat the materials properly, but the superintendent states that under the roof salamanders were kept burning the following Monday and Tuesday. He further stated that the only frozen concrete which he discovered was a top layer, about $\frac{1}{4}$ in. thick, on the roof surface, and that this was removed and replaced with good cement mortar troweled on. The weather after the date of pouring was usually at freezing or colder and has been below zero many times.

Top of Columns Poured with Roof

The columns had been poured a day or two previous to the slab, and evidently stopped about 18 in. below the girder bottoms. The upper portion, poured with the roof system, seems much more porous and loose than the other work. The impact of the falling roof where skylights were located was sufficient to break through the concrete of the floor below, but the reinforcing steel held the shattered floor concrete so that no collapse of this floor occurred. The roof fell through a distance of about 15 ft. A portion of



this shattered concrete was removed, leaving a hole through which the debris from the roof was shovelled to the ground below.

Concrete Very Dry

When the photographs were taken practically all of this debris had been so disposed of and was being removed in wagons. There was one large loose pile resembling dry mixed materials, but hardly as damp in appearance as that

usually is. Many pieces of crushed rock were entirely free of cement. On the floor above were still several large pieces of the wall girders. These were being broken by means of sledges and drills. This concrete had a well-mixed and rich appearance, but gave the impression of concrete which had been frozen hard and was warming up.

Two days previous, on Feb. 25, the weather had suddenly turned very warm, the thermometer going to 68



CONCRETE AROUND EDGES OF BREAK STATED TO BE IN CRUMBLING CONDITION—FLOOR BELOW WITHSTOOD HEAVY IMPACT WITH ONLY LOCAL PUNCTURES

deg., maximum, at 4 p. m., and it is reported that salamanders had been kept burning under the roof for several days. The finishing of the second floor had begun on the morning of the day of the failure, and at that time practically all shoring had been removed from the roof and the building brought up to a suitable temperature.

The portions of the roof still standing have a very dry appearance, and the shattered concrete at break lines is usually dry and loose. Apparently no attempt had been made to supply moisture to compensate for the drying action of the artificial heat and the dry weather.

No Broken Bars Found

The main slab of the second floor between joists is generally 2 in. thick, except adjacent to the carrying beams. Several holes were punched through these thin slabs by the falling material, but in all cases the reinforcing material held, thus preventing collapse of this floor. A careful examination of the reinforcing material from the collapsed portion of the roof failed to disclose a single case of broken bars, in spite of the fact that a great proportion of the bars were bent into all manner of shapes and many of the bent bars almost entirely restraightened at the bends. While before the photographs were taken much of the reinforcing steel had been cut away, after the collapse the reinforcing steel was still in place, so far as the ends projecting into the unfailed portions were concerned.

The large photograph shows particularly a girder which broke off at the "quarter point," just where the main steel was bent up. A sort of continuous stirrup has been used throughout this building, and the whole stirrup reinforcing was pulled away with the surrounding concrete. In many cases the beam stirrups were almost entirely straightened out, and all steel, except in a few minor cases, was left clean of surrounding concrete.

At the remaining skylight header no stirrups are in evidence on the far side, but on the side next the adjacent columns stirrups are to be seen, showing where peeling has occurred.

A portion of the debris was taken from the general pile and mixed with water, after screening out the stone with a No. 16 sieve. This showed initial set in 24 hours, was set hard in 48 hours, and would show at least a 50 lb. tensile strength at the age of 66 hours.

Urge Oregon Highway Engineer Be Given More Power

At the recent annual meeting of the Oregon Society of Engineers, in Portland, Ore., J. P. Newell, one of the principal speakers of the evening, urged that the state highway engineer be given more complete charge of highway construction, with a view of unifying the work. The speaker pointed out that with 800 road supervisors participating in the direction of road construction, the state is getting highways built under a variety of systems.

Dam Colorado River in Grand Cañon

Work of constructing the first of three giant dams and hydroelectric plants in the Grand Cañon of Colorado River will be started in March, according to J. B. Girard of Phoenix, Ariz., engineer for the project. The initial dam will be constructed about 21 miles north of Peach Springs, Ariz., at a point where the cañon is very narrow and the inclosing walls reach 1500 ft. above the water level. In order to get material to the site, either a spur track will be built from the Atchison, Topeka & Santa Fe Railway at Peach Springs or a road will be constructed to allow the use of motor trucks.

It is proposed that the power generated by the plant will be sold to the numerous mines and mills in the vicinity at approximately \$4 per horsepower month. It is said that it is now costing these mines and mills \$8 to \$15 per horsepower to generate their own power by steam. Upon the completion of the first project the available power will also be used in the construction of the other two. With the three plants in operation approximately 1,000,000 hp. can be generated. It is said that a market for this power will be found in northwestern Arizona and southern Nevada and Utah, a territory where there are not only many mines and mills, but which is rich in lumber and offers great opportunities in agriculture, provided power for pumping is available. The W. L. Clark Construction Company, of New York City, has an engineer on the site who is checking up plans and estimates.

Denver Steel Plant Plans Develop

Encouragement and every possible support on the part of the Civic and Commercial Association of Denver, Col., are extended to John A. Crook, proprietor of the Monarch Iron Works of Falls City, Neb., and Kansas City, in his determination to establish in Denver a factory, the output of which shall be structural steel of the sort necessary in large building operations and bridge work. Following conferences with officials of the association Mr. Crook recently closed a deal whereby the Lowth Iron Works at First and Larimer streets will be taken over as the nucleus of the new concern.

Cleveland Water Main Breaks

A 36-in. water main which broke at Cleveland, Ohio, Feb. 18 resulted in the flooding of nearly a square mile of streets, the filling of hundreds of cellars and a property damage estimated at \$75,000. The break, which occurred early in the morning, is believed to have been caused by earth settlement under the pipe due to cold weather. The main, which had been in service eighteen years, had a piece 6 ft. long and 2 ft. wide broken from it. Frost had penetrated to a depth of 3½ or 4 ft. near the point where the break occurred.

Organize Engineers' Country Club on Long Island

An engineers' country club, with house and grounds on Long Island, has recently been organized and is promised to afford for its members all privileges of sport as well as that of community living. It is intended to develop about 240 acres of cultivated and cleared land, already obtained, on the north shore of Long Island near Roslyn. A manor house, at present on the grounds, will be altered to fill the needs of an all-year club house, 20 miles from Columbus Circle.

The engineers' country club will have 500 resident members, living within 50 miles of the club, and not less than 500 nor more than 1000 non-resident members, living over 50 miles from the club. Engineers by profession, members of engineering societies and those closely allied with the engineering profession are eligible for membership. Charles F. Quincy, of New York, is the president of the club. N. M. Garland, 30 Church Street, New York City, is chairman of the membership committee.

Compensation Laws of Three States Upheld in Supreme Court

The laws of three States as to workmen's compensation to be paid in case of personal injury or death in the performance of duty were, March 6, upheld by the U. S. Supreme Court in cases brought on appeal from the States of New York, Iowa and Washington.

The general principles underlying the cases were practically the same. The New York case was that of the New York Central Railroad in which a watchman was accidentally killed. The court opinion, sustaining the New York law, stated that he who expects to derive an advantage from an act done by another must answer for any injury the third person may sustain in such performance.

Pacific Coast Proposes Military Highway

The Pacific Coast Defense League has filed articles of incorporation at Olympia, Wash., with the object of securing the construction of a military highway from the Canadian to the Mexican border on the Pacific Coast. Congress will be asked immediately to make an appropriation for such a highway.

Backing the league in this movement will be the legislatures of Oregon, Washington and California. The Oregon legislature has already adopted a memorial to Congress, a similar one will be offered in the Washington legislature, and the third will be taken up by the California legislature in March. While the need of a military highway for coast defense has been talked of for some time, this is the first occasion when concerted action by the three Pacific Coast states has been possible.

What Engineers and Contractors Are Doing

E. B. MENEZ, district engineer of the New York Central Railroad at Albany, N. Y., has been appointed assistant valuation engineer, with headquarters at New York City. Mr. Menez was born in Ohio in 1875, and was educated at the National Normal University, Lebanon, Ohio. In 1898, after various city and county work, he entered the employ of the Baltimore & Ohio Southwestern Railway, where he remained until 1901, having meanwhile been made acting resident engineer. The next three years found him on various railroad construction west of the Mississippi River, with the Choctaw, Oklahoma & Gulf and the Missouri Pacific Railways and the White River Railroad. For a short time, also, he was with the city department at Columbus, Ohio. He came to the New York Central in 1904, and was first in charge of the general drafting room for the electric zone. Next he became a member of the chief engineer's special staff and had the handling of engineering agreements. Late in 1909 he was appointed engineer of grade crossings, and in the spring of 1912 was promoted to the office he now leaves.

N. F. THOMPSON, assistant district engineer of the New York Central Railroad at New York, has been made district engineer at Albany, succeeding E. B. Menez, promoted. Mr. Thompson was graduated from Rensselaer Polytechnic Institute in 1907. Except for a short period with the Delaware & Hudson Company his engineering work has been entirely with the New York Central. In the grade-crossing office he was successively draftsman, assistant engineer, assistant engineer of grade crossings and engineer of grade crossings, reaching the latter position in the spring of 1912. A year ago he was promoted to assistant district engineer of the New York district.

S. L. RICE, having resigned from the position of office engineer, Delaware, Lackawanna & Western Railroad, the position has been abolished.

CLARK R. MANDIGO has resigned as assistant engineer for the Portland Cement Association to accept the position of consulting engineer for the Western Paving Brick Manufacturers' Association, Dwight Building, Kansas City, Mo. Mr. Mandigo, who was formerly assistant city engineer of Kansas City, Mo., will have charge of the service and promotional department for the brick association, which operates over most of the territory between the Mississippi River and the Rocky Mountains.

TOWL ENGINEERING COMPANY has changed its office from 1119-22 City National Bank Building to 1420-1 First National Bank Building, Omaha, Neb.

B. F. CRESSON, JR., whose resignation as chief engineer of the New Jersey State Board of Commerce and Navigation was announced in the Engineering Record of March 3, page 367, was educated at Lehigh University and University of Pennsylvania, and since receiving his degree from the latter school in 1894 has been actively engaged in engineering practice. For six years, until 1900, he was connected in various capacities with several different railroads, among them the Lehigh Valley Railroad, Pennsylvania Railroad and the Reading Subway work in Philadelphia. From 1900 to 1901 he was in the office of Jacobs & Davies, con-

neer to the board while engaged in private consulting practice at 50 Church Street, New York City. He has been retained by the Board of Dock Commissioners of Norfolk, Va., to prepare for them a harbor development plan.

E. A. WIDMAN is at present chief draftsman with the Slidell Shipbuilding Company, Inc., Slidell, La. Mr. Widman received his education and early experience in shipbuilding in England, and later came to the United States, where he has had fifteen years' experience in building grain elevators, floating elevators, power plants, refrigerating plants, etc. Previous to his present position Mr. Widman was for a short time with the W. Backers Chemical Company, Brooklyn, N. Y.

J. F. BROWN, civil engineer and superintendent of construction, Quartermaster Corps, War Department, has been transferred from Fort Slocum, New York, to El Paso, Tex. At his new station Mr. Brown will supervise the construction of a complete water-supply and distribution system and sewerage system on the Fort Bliss military reservation. The project involves the expenditure of nearly \$100,000. Mr. Brown was graduated from the engineering school of the University of Kansas in 1911, and was employed as superintendent of buildings and grounds at the University of Kansas, Lawrence, Kan., until March, 1914, when he accepted an appointment from the War Department as civil engineer and superintendent of construction, and was stationed at Fort Slocum, New York.

R. C. STORRIE, for many years a well-known contractor of San Francisco, and builder of the Mile Rock and Twin Peaks tunnels, was recently injured by a blast at Las Vegas, N. M., where he has a construction job under way. The charge exploded unexpectedly while Mr. Storrie was standing near, and flying debris caused injuries which, it was feared, would result in the loss of his right eye. Later reports indicated that the eye would be saved.

J. W. MORRIS, former city engineer, Portland, Ore., has been appointed consulting engineer of the Oregon State Motor Association. His duties will be to log all the roads throughout the state, prepare maps for the benefit of motorists, organize local automobile clubs in various communities, which will be affiliated with the state organization, and spread the gospel of statewide co-operation in good roads.

C. E. JOHNSTON has been promoted from the position of chief engineer of the Kansas City Southern Railway to that of general manager, with headquarters at Kansas City, Mo. Mr. Johnston began work with this company as a locating engineer and has been chief engineer since 1911. Since 1897 he has been in railroad work, beginning in that year as a chainman in southern Illinois. Mr. Johnston is 35

Resigns as Chief Engineer of New Jersey State Board of Commerce and Navigation



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B. F. CRESSON, JR.

sulting engineers, New York City, on subaqueous tunnel plans and surveys of the North and East rivers. In 1901 he was assistant engineer on resurvey plans for the completion of the Hudson tunnels under the North River (McAdoo tunnels). From 1901 to 1910 he was assistant engineer, alignment engineer and resident engineer in charge of precise triangulations on the North River, resident engineer in charge of a section of the subaqueous tunnels under the North River and resident engineer in charge of a section of the Pennsylvania terminal in New York City. He was appointed first deputy commissioner of docks of New York City in 1910, during which time he visited Europe to study important harbors. From 1913 to 1915 he was chief engineer of the New Jersey Harbor Commission, and in the latter year was appointed chief engineer of the New Jersey State Board of Commerce and Navigation. Mr. Cresson will become consulting engi-

years old and is reported to be the youngest railroad general manager in the country.

C. B. CLEGG has been appointed acting division engineer of the Pecos division of the Atchison, Topeka & Santa Fé Railway, with office at Clovis, N. M. He succeeds J. W. Walker.

FRANK HELM has been appointed division engineer of the Atchison, Topeka & Santa Fé Railway, with office at Slaton, Tex. Mr. Helm holds a newly created position.

C. LOUIS ZULL has resigned as inspector on Ohio River lock and dam construction, and has become architect's superintendent with the firm of Ritter & Bates, of Portsmouth, Ohio, and Huntington, W. Va. Mr. Zull was educated at the University of Cincinnati.

W. S. BARSTOW MANAGEMENT ASSOCIATION, 50 Pine Street, New York City, is announced by W. S. Barstow & Company, Inc. The new firm will supervise the management of all public-utility properties controlled by the General Gas & Electric Company, the Eastern Power & Light Corporation and W. S. Barstow & Company, Inc. E. L. West has been elected president of the corporation.

Obituary Notes

WILLIAM HENRY BALDWIN, for nearly ten years deputy city engineer of Yonkers, N. Y., died March 6 at his home, 103 Warburton Avenue, in that city. Mr. Baldwin was born in Nashua, N. H., and was a graduate of Dartmouth College, class of 1859. He had charge of municipal engineering projects in Memphis, Buffalo and Norfolk. In 1888 he was made engineer of the Yonkers Water Department, and when in 1908 the city was formed he became deputy city engineer. Mr. Baldwin was seventy-five years old. He served in the First New York Volunteers during the Civil War.

FRANK GILBERT, of the firm of Gilbert Brothers, engineers and contractors, died recently at his home in Westmount, Canada.

S. F. BULLARD, civil engineer, of Tacoma and Centralia, Wash., died Feb. 14 in Tacoma. He had been a resident of Tacoma since 1890. Mr. Bullard was a graduate of the University of Illinois and for many years was associated with the present city engineer of Tacoma, L. A. Nicholson, under the firm name of Bullard & Nicholson. He served as assistant city engineer of Tacoma during 1904-1911 and was city engineer of Centralia, Wash., during 1907 and 1908.

COLONEL WALTER KATTE, who was for fifty years active in railroad and bridge construction in this country, died suddenly March 4, at his home, 784 Park Avenue, New York

City, in his eighty-eighth year. He was the first chief engineer of the Second and Ninth Avenue elevated roads, New York City, and he was identified prominently with the construction of the West Shore Railroad. Colonel Katte was born in London, England, and was educated in King's College. He came to this country in 1849 and his first engineering work was done in the West and Middle West. For four years he was in charge of the construction of the Eads steel arch bridge over the Mississippi River at St. Louis, and for

Famous Railroad and Bridge Engineer Dead



COL. WALTER KATTE

ten years he was engineer and secretary of the Keystone Bridge Company at Pittsburgh, Pa. His railroad work included ten years in the service of the Pennsylvania Railroad, and he was also at one time chief engineer of the Ontario & Western Railroad. From 1886 to 1898 he was chief engineer of the New York Central & Hudson River Railroad. He resigned that place to retire to private life. One of the thirteen founders of the Western Society of Engineers, the Colonel was recently elected an honorary member of the organization. He was one of the early members of the American Society of Civil Engineers and served two terms as director of the Institute of Civil Engineers, London. In the Civil War Colonel Katte was assigned in 1861 as Colonel in the service of the United States Military Railroad and Telegraph Department. His duties were those of constructing engineer for military bridges and railroads in Maryland, the District of Columbia and Virginia.

GEORGE ANDREW HOBSON, a prominent English engineer, and until some few years ago a member of the firm of Sir Douglas Fox & Partners,

died Jan. 25 at Richmond, England. Mr. Hobson received his early education at King James' School, Knaresborough, and afterward for three years studied science and mathematics at the Watt Institute, now incorporated with the Heriot-Watt College at Edinburgh. In 1871 he became an articled pupil at the Tees Engineering Works, Middlesbrough, and when just over twenty years of age was made chief of the drawing office. In 1880 he became chief assistant to Sir Douglas Fox and continued in that capacity for twenty years, during which time he was engaged on work connected with the Mersey tunnel and railway, the Hawarden Bridge over the river Dee, Liverpool Overhead Railway and the Great Central Railway extension to London. He was responsible for and was associated with railway work in India, Argentina, Colombia and other countries, and with extensive granaries at Buenos Aires, but it was in South Africa that his work abroad was most extensive and beneficial. Much of the bridge and structural steelwork on the lines connecting the Cape Colonies with Rhodesia, totalling in all more than 2500 miles of railway, was designed by him. One of the finest examples of his work is the bridge over the Zambesi River at Victoria Falls. It is notable as having the greatest combined height and span of any similar structure yet built, the central span of 500 ft. having a rise of 90 ft., while the height from low water to rail level is 363 ft. Mr. Hobson was a member of the Institution of Civil Engineers and was also a member of two of the engineering standards committees. In 1900 he received the Telford premium and gold medal and in 1907 the George Stephenson gold medal.

ERNEST L. RANSOME, since 1859 engaged in the study, use and manufacture of artificial stone, and to whom there are credited inventions and numerous important works in concrete, died March 5 at Plainfield, N. J., in his seventy-third year. Since entering as an apprentice in his father's factory at Ipswich, England, nearly sixty years ago, Mr. Ransome's whole life had been given up to the study of concrete and its applications. He was superintendent for four years of the Pacific Stone Company of San Francisco when the new process of artificial stone-making was introduced into this country in 1870. He was one of the first, if not the first, to use cold-twisted square bars for reinforcing and he holds patents on methods of forming joints in concrete, use of lime and clay and salt in concrete, use of coil joint for uniting reinforcing bars and other patents as well. He was for several years president and consulting engineer of the Ransome Engineering Company, and was an associate member of the American Society of Civil Engineers, charter member of the Western Society of Engineers, honorary corresponding member of the American Institute of Architects and member of the Royal Society of Arts.

Railroads Expect Greater Shortage of Labor

Statements Indicate That Construction Work Would Break Records During Coming Season if Labor Supply Would Permit

ENGINEERS in charge of maintenance work on important railway systems throughout this country and Canada consider in general that construction work to be carried out by their lines will be curtailed by the inadequate supply of labor, according to opinions expressed in the March issue of the *Railway Maintenance Engineer* in response to a request for information sent out by that journal. Although the labor field covered by these replies is slightly different from the construction field, the opinions expressed bear out the analysis of the labor situation given in the Engineering Record of Jan. 6 last, and indicate that throughout the northern sections of the country where conditions early became acute the labor shortage is expected to be no more severe than last year. On the other hand, it is indicated that railroads in this territory, in common with many other industries, have imported large quantities of negro labor from the South, and that a serious shortage is expected to be felt there for the first time during the coming season. Also, it is pointed out that under present conditions it is difficult for the Southwestern roads to recruit Mexican labor across the border, and that some shortage is being felt on this account. As for the Pacific Coast, it is shown to have been necessary for some roads to raise wages during the past season, and while wages were dropped to the former level during the winter, it is expected that they will have to be advanced when the lumber and agricultural season opens. It is reported to be extremely difficult to maintain an adequate supply of labor near large cities. While an acute shortage has, of course, existed in eastern Canada, things are not so bad in the Canadian Northwest. However, in common with our Western agricultural territory, the available labor is expected to shift to the farms during the summer, and some roads are planning to accomplish the greater part of their construction work before this takes place.

Buildings

The larger building projects noted in this issue are summarized below:

Contracts awarded	Kind	Cost
Dayton, Ohio	Bank	\$450,000
Rock Island, Ill.	Munitions plant	1,250,000
New Orleans, La.	College building	767,000
Proposed work:		
Atlantic City, N. J.	Hotel	1,750,000
Wheeling, W. Va.	Steel plant	20,000,000
Youngstown, Ohio	Railroad shops	500,000
Cincinnati, Ohio	Courthouse	500,000
Chicago, Ill.	School	320,000
San Francisco, Cal.	State building	1,000,000

Roads and Paving

Five highway contracts amounting to \$378,000 have been awarded at Fayetteville, W. Va. The lowest bid received

at Cleveland, Ohio, for paving construction on Euclid Avenue was \$124,000. Bids are desired March 14 at Fargo, N. D., for highway construction to cost in the neighborhood of \$300,000. Proposed work noted in this issue is summarized in the following table:

	Kind	Cost
Rustburg, Va.	Highways	\$240,000
Tarboro, N. C.	Street improvements	250,000
Spartanburg, S. C.	Highways	1,000,000
Jacksonville, Fla.	Paving	775,000
Greenwood, Miss.	Highways	600,000
Ashland, Ohio	Road work	250,000
Dallas, Tex.	Paving	500,000
Portland, Ore.	Highway construction	250,000

Waterworks and Sewers

Judging from the news of work reaching the Engineering Record, construction in this field may be much more active during 1917 than last year. Work noted in this issue is summarized below:

Contract awarded	Kind	Cost
St. Paul, Minn.	Reservoir	\$246,000
Bids opened:		
East St. Louis, Ill.	Sewer	386,000
Proposed work:		
Pawtucket, R. I.	Sewers	400,000
Philadelphia, Pa.	Waterworks extensions	500,000
Allentown, Pa.	Sewage disposal plant	2,000,000
Bethlehem, Pa.	Reservoir	250,000
Springfield, Ill.	Water mains	175,000
Quincy, Ill.	Waterworks extensions	197,000
Grand Rapids, Mich.	Sewers	158,000
Milwaukee, Wis.	Filtration plant	3,000,000
Wichita, Kan.	Sewer	200,000

Miscellaneous Headings

A contract has been awarded for constructing a power plant to cost \$6,000,000 at Wateree, S. C. A dock contracted for at Seattle will cost \$350,000. Bids are desired April 3 at Philadelphia for three additional sections of the Broad Street subway.

The bill appropriating \$45,000,000 for flood control on the Mississippi River, not more than \$10,000,000 of which is to be spent in any one year, passed both the Senate and House at Washington. It is reported that the Lehigh Valley Railroad will expend \$5,000,000 during 1917 for work including the completion of four-tracking its line from the anthracite fields to New York harbor. The naval appropriation bill includes provision for a \$750,000 drydock to be constructed at Charleston, S. C. Reports from Youngstown, Ohio, state that the Erie Railroad will expend \$5,500,000 for construction improvements. Plans are being prepared for a steel bridge to cross the Ohio River at Louisville, Ky.

A survey of a drainage district near Helena, Ark., which will cost \$3,778,000 has been completed. Plans for the construction of a hydroelectric plant at Rochester, Minn., to cost \$600,000, are said to have been completed. Applications have been made to the state water commission of California for permission to use water for an irrigation project to cost \$800,000 and for hydroelectric developments to cost \$7,500,000. San Diego, Cal., provided \$682,000 on Feb. 21 for the reconstruction of the Lower Otay dam. Three dams to cost \$927,000 are to be built in connection with the flood-control work at Los Angeles.

WATERWORKS AND SEWERAGE SYSTEMS

PROPOSED WORK

Pawtucket, R. I.—City Council reported to have voted to ask legislature to authorize \$800,000 bonds to be used for sewer and highway improvements.

Woonsocket, R. I.—Reported Bd. Sewer Comm. on sewer construction of South Main St. trunk sewer; cost \$12,000. M. H. Proulx, city eng.

Canandaigua, N. Y.—Reported city has a proposal of bond for construction of sewage disposal plant.

Potsdam, N. Y.—Village will hold election some time in March on question of issuing \$150,000 bonds to be used for waterworks improvements between Barton Brook and Potsdam.

Bayonne, N. J.—City is desirous of purchasing plant and system of New York & New Jersey Water Co., for which \$3,000,000 is asked. Bayonne is willing to pay \$600,000 after receiving advice of engrs.

Passaic, N. J.—Bd. Comrs. have decided not to construct the \$50,000 Paulson Ave. storm sewer, owing to the impending war situation and present high cost of materials.

South Orange, N. J.—Clyde Potts, 30 Church St., New York, has drawn plans for trunk sewer system for South Orange Twp., Rahway, Cranford and other municipalities that may care to enter the project. A. W. Hemphill, of Montclair, reported head of private interests, which are considering the construction.

Westfield, N. J.—Clyde C. Hill, village engr., writes election will be held Mar. 20 on question of improving present waterworks; cost \$80,000. J. A. Riley, village clk.

Kittanning, Pa.—Reported city considering construction of waterworks. H. J. Walter, ch. of Council.

Allentown, Pa. Site has been purchased for sewage disposal plant and sewer system will be installed; cost about \$2,000,000.

Bethlehem, Pa.—Ross Common Water Co., of Ross Common, plans construction of 300,000-gal. capacity reservoir; cost \$250,000.

McKeesport, Pa.—City considering extensive improvements to waterworks, including additional mechanical filters, high service distributing system, stand pipe, clear water reservoir, new pump and power house. Leo Hudson, engr., 802 House Bldg., Pittsburgh.

Monaca, Pa.—Boro. Engineer Michael Baker in his report on proposed waterworks improvements recommends installing additional power at waterworks and improving reservoir; though investigation revealed cost of installing 2 new centrifugal motor driven pumps each having 1,000,000-gal. capacity, would not cost any more than it would to put present pump in working order; cost of 2 new pumps installed, \$10,000 also 1,000,000-gal. capacity reservoir at \$10,000.

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The Railroad Strike

AS this page went to press the unofficial announcement came that the railway trainmen would strike to-day at 6 p. m. It appears that they are unwilling to await the decision of the Supreme Court on the constitutionality of the Adamson law, though this decision is expected any time now. According to the reported plan, the public will be given several days to adjust itself to the suspension of business, or to force the railroads to submission. This evening the freight men are to go out on a number of Eastern and Southern trunk lines; Monday, March 19, the remaining Eastern and Southern lines are to be included; Tuesday, the freight trainmen on the Western lines will be called out, while Wednesday, if the companies have any fight left, passenger service will be suspended. Thus Congress in two sessions has utterly failed to remove the danger of paralysis of industry, and in spite of the ignominious surrender of last August, the strike has not been prevented, but only postponed to a time when it can do more damage. The patriotism of the brotherhood leaders—this journal cannot believe they represent the spirit of the rank and file of the brotherhoods—in forcing their issue at such a time as this, when we should be absolutely united, needs no comment. It is to be hoped that the President will find a way to deal adequately with the situation, without delay or undue ceremony.

Ethics Through Examples

IT IS EVIDENT that the American Institute of Consulting Engineers recognizes, in its recently published solutions of ethical questions, that these things depend upon consideration of circumstance and consequence. The Institute removes the matter from the field of speculation and intuition and sides with the philosophic school which holds ethics to be positive and experimental. It is certain that while experience has shown that an authorized and definite code of conduct is generally subversive of moral stamina through its absorption of personal responsibility, still ethics must be made work-a-day to a considerable degree, for they can then, if not slavishly followed, serve as guiding lights, or as points of departure when a particular situation finds an individual unprepared by his own experience. Of course, no code can satisfy all conditions. Even the Kantian "categorical imperative" comes to defeat under a tension such as war brings. Engineering, like war, is in practice a far more developed complex than when considered speculatively and coldly as a science. When it enters

the world of commerce it gathers the burdens of human nature, suffering the distress of the desire for gain, via the easiest way. Its problems become those of business as well as those of the laboratory. While certain modern schools of psychology seemingly have disproved the existence of the conscience, still it is impossible to deny that the pleasantness of life is almost entirely the contribution of virtuous conduct. So, to no matter what data of ethics one subscribes, the action of the Institute must be judged favorably and as a contribution to the greater good of the profession.

Safeguards at Drawspans

MANY engineers would consider that the practical limit of public protection at a drawbridge approach had been reached when the customary gate had been lowered, a bell rung and attention directed to a warning sign of more or less prominence. Not so with the engineers of the Chicago Bridge Department. They have gone to greater lengths in developing safety-first plans. On page 425 of this issue, F. H. Avery describes new gate devices designed to prevent accidents. The warning prior to the opening of the draw is given by a series of electric bulbs attached to the gates themselves and so strung across the entire roadway that an approaching automobile or electric railway car cannot fail to receive the flash in time. But even this is not considered sufficient, as it is assumed that carelessness is an inborn human characteristic which every designer must consider. A heavy sliding boom is therefore constructed to stop a 4000-lb. motor vehicle traveling 30 miles per hour. Accidents happen every day, but many of them, as observed at Chicago, could be averted. Designing engineers on bridges and other structures can save the expense of many damage suits.

Costilla Dam Construction

ANOTHER dam is being built in the Rocky Mountain country by the alternate small trench and ridge method. Despite the cost of the method, which is considered prohibitive by some engineers, the advantage of being able to control the amount of saturation in the small units and prevent any definite horizontal layers led the engineers on the Costilla Estates project to choose this type of construction, as described on page 430. A 100-ft. dam built on this same principle across the headwaters of the Rio Grande for the Farmers' Union four years ago has been successful. In the latter structure, described in the Engineering Record of Nov. 9,

1912, page 508, the earth section was built as a heavy blanket against a rock section because of the scarcity of earth in the vicinity. In the Costilla dam one of the interesting points is the use of heavy cast-iron pipes for outlets and to carry the flow of the river during construction, following the practice at the Standley Lake dam. It was vitally important that the outlet conduit be absolutely tight. Investigations indicated that the Union Pacific had placed many heavy fills over cast-iron pipe laid on concrete without cracking the pipe or breaking the joints. On the Costilla dam, however, the engineers took special precaution to lay the pipe on concrete cradles and introduced a slab support to take up the earth pressure. As a further safeguard the pipes were tested before being covered so as to determine the effectiveness of the calked joints. These measures to insure the permanency of the structure are well worth all they cost.

Reasons for Proficiency in English

IN AN ADDRESS delivered recently before the Association of Urban Universities, Alfred D. Flinn, deputy chief engineer of the New York Board of Water Supply, laid particular stress on the fact that if a young man aspires to the higher ranks of municipal engineering he must have a mastery of English sufficient to enable him to speak and write accurately, discriminatingly, and effectively. Particularly to the municipal engineer is this important, for he must prepare contracts and specifications clearly defining work to be done, and these should be written in such a manner that there will be a minimum of opportunity for dispute and complaint. He must be able to write and prepare special and periodic reports which should be interesting as well as informing. It is through them, and through them alone, that the intelligent support of the public can be obtained for projects or for work under way. He should have enough facility in the writing of clear understandable English to be able to prepare interviews or magazine articles through which he can gain and hold the intelligent support of the public. Further, he should be able to present engineering subjects orally to boards, committees or public gatherings in understandable terms and give unmistakable instructions. Somehow it seems that throughout the entire engineering profession men are continually arising to demand that the engineer prepare himself for higher duties than the mere routine performance of routine matters. In the presidential addresses before the annual meetings of national engineering societies for several years past this note has been persistently sounded. Among the members of the local engineering organizations the same sentiment is steadily spreading. There is the growing sense of a higher and further destiny for the engineer. His present inadequacy to the newer tasks being given him is becoming more and more apparent. Where will be found the agency through which this may be transmuted from a purely passive to a thoroughly active idealism?

The Fiscal Side of Paving

THE DECISION as to the selection of paving methods and materials often turns as much upon the engineer's knowledge of, or unreasoned preference for a particular combination as upon definite engineering considerations. In some cases the activity of the producing interests carries more weight than the actual ability of the pavement to meet the requirements. The points on the curve of value are few as yet, but pavement must be laid, and, if an extrapolation should prove to be incorrect, the engineer should not be criticized too severely for erring humanly.

It has become trite to mention the high speeds and unusual loads of motor trucks and to lay to their door the new problem. This is so proximate a cause that we overlook the freight elevator, for instance, which has made the rapid handling of large stores from congested warehouse districts possible. We are too apt to consider that present conditions will obtain always, that we must meet them as they are now manifest and determine with mathematical precision the economy of pavement types whose life is estimated at as much as 40 years.

But, to reiterate, pavements must be laid. We can neither follow the wild dreams of prophets who predict unique ways of handling commerce nor should we temporize and lay materials which patently will last less than a decade, merely on account of low first cost. Undoubtedly there will be a vast intensification of present traffic density and an increase in its destructiveness before a radical change in present methods of freight handling will be found unavoidable. In a situation such as now exists, every theoretical treatment of the fiscal problem of paving is timely and valuable, and such illustrative considerations as those of Mr. Connell's appearing on page 419 of this issue should receive intensive study.

Water Sales Promotion

A DOLLAR down and the balance in regular installments, or some other partial-payment plan, is the proposed new method of promoting the use of water. It is a rare thing to hear waterworks men discuss new-business possibilities, selling methods and all the other promotion measures of modern business. Nevertheless, a few water companies are "going after" business, instead of waiting for customers to beg the company to take their money.

In Indianapolis only two-thirds of the available water business is on the books of the company, and a recent investigation showed that some kind of a partial-payment plan would increase the business and, at the same time, eliminate insanitary conditions due to open vaults and unsafe wells. That sanitary engineers and health enthusiasts usually ride rough-shod over the opposition to sanitary progress by the poorer classes, without any attempt at a solution of the problem for the individual small-house owner, was the indictment served on sanitarians at a recent meeting of the Indiana Sanitary and Water Supply Association by a former newspaper man,

now the publicity man for the local water company. It is his proposal, as set forth on page 416, to establish a partial-payment plan patterned after that so generally used by the gas and electric utilities. His scheme for financing sanitary improvements is the first public exposition of a serious study of Indianapolis conditions. The funding company, or branch of the existing company, has not yet been formed, but in all probability it will be established this year.

Undoubtedly there are unknown difficulties to be met, but no great errors need be made, for the more progressive utilities have paved the way. Discussions of the subject in this journal are invited and should be continued at coming waterworks conventions, for cities with municipally owned plants need the added impetus toward community health, even though they do not need the business. Not for some time has a more definite aid come to the sanitarian in his campaign for civic betterment.

New York Connecting Railroad Dedicated Last Week

WITH the dedication on March 9 of the New York Connecting Railroad was realized the dream of a quarter of a century—a direct rail connection via the Hell Gate bridge, between New England and the South. Twenty-five years ago was conceived the idea of this physical connection through New York City between the manufacturing centers of New England and the markets and sources of raw materials in the territory west and south of the Hudson River. Although other names than those of Samuel Rea and Gustav Lindenthal are associated with the earlier Hudson River bridge and the Steinway tunnel projects, which marked the beginnings of this scheme, only these two have remained to achieve final success and witness the fruition of their plans. In the presence of officials and engineers of the three railway systems concerned, the completed passenger connection, including the largest arch bridge in the world, was dedicated to the transportation service of the country and transferred to the New York, New Haven & Hartford Railroad Company, which is to have charge of its operation.

The section of the New York Connecting Railroad joining the New Haven at Port Morris in the Bronx with the Pennsylvania System at the Sunnyside Yard of the Long Island Railroad, over which the federal express between Washington and Boston will be restored to service within a short time, is about 6 miles in length. Of this distance, $3\frac{1}{2}$ miles is occupied by the great steel arch bridge over Hell Gate and its steel and concrete viaduct approaches. Two tracks of this four-track line will be used for the operation of passenger trains. It is these tracks which are now to be opened to traffic.

Perhaps of greater economic importance, however, is the two-track freight branch which connects the road with the terminal yard at Bay Ridge, Brooklyn. Directly opposite the Greenville yards of the Pennsylvania Railroad, the connection at Bay Ridge with the New

England lines will shorten the water transfer of freight in New York Harbor from 20 to $3\frac{1}{2}$ miles. A short section of this line is still under construction. When it is finished, the delays and dangers of transferring freight by the tortuous water route through the East River and Hell Gate will be at an end.

State Compensation Laws Valid

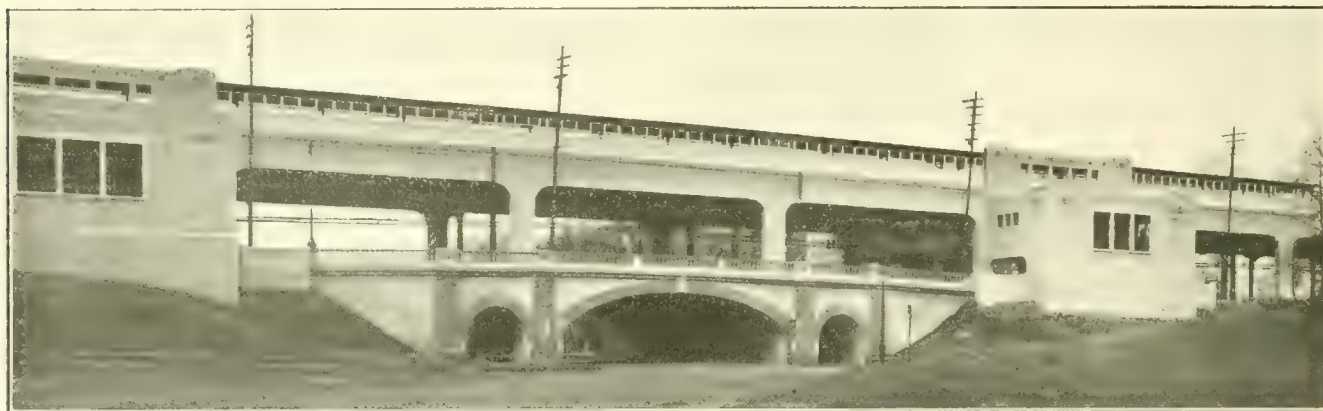
THE SUPREME COURT of the United States, in decisions handed down last week, upheld the workmen's compensation laws enacted by New York, Iowa and Washington. It is evident from these decisions that the right of states to enact laws compensating workmen injured in the discharge of duty without fault of the employer is unquestioned. In the decision regarding the case arising under the New York law it was also held that the New York Central Railroad, an interstate corporation, was liable under the state law rather than under the provisions of the federal employers' liability law for the death of an employee of its construction department whose duties were discharged wholly within the state of New York. The right of states to control compensation for injuries to industrial workers to the fullest extent is thus upheld.

While public assumption of the risks of industrial employment through state liability insurance, which has been upheld by the decisions, doubtless places everyone on an equal footing and does away with many of the injustices prevailing under the old system of redress at common law and private liability insurance, it must be borne in mind that neither this equality nor the prompt adjustment of accident claims is the final goal toward which those most interested in the problem of industrial accidents are striving. Such accidents are a net public loss, no matter how promptly or fairly the derangements resulting from them are adjusted. The object of all state or other regulation of the hazards of industry should be the ultimate elimination of accidents. Removing this problem from private insurance companies, which had already made a beginning of accident-prevention work, and turning it over to political administration does not mean that all the difficulties connected with it have been solved. It means rather that the legislators and the state executives under whose direction this work must go on must be brought to see, where they do not already recognize the principle, that the most important function of state regulation is not to compensate for injuries received but to prevent injuries and the necessity for compensation.

Readers of this journal who are employers should spare no effort to be of service in the work of making sure that the state administrations which have shouldered this problem approach it with the point of view here given. Should this view prevail, there is no doubt that the consideration of the question by the state governments as a public problem can result in greatly hastening the day when unnecessary risks now common to industrial employment will be things of the past.

Steel in New York Elevated Station Hidden by Ornamental Concrete

Arches Carry Jerome Avenue Line of Subway Extension at Mosholu Parkway Station—Inlaid Tile and Symmetrical Stair Towers Are Architectural Features



ONE of the structures recently constructed as part of the new dual system in New York City, mentioned by S. J. Vickers in the paper abstracted on page 267 of the Engineering Record of Feb. 17, describing how concrete ornamental elevated stations should be treated, was the Mosholu Parkway Station on the Jerome Avenue line. The structural details of this station, which was built above an existing concrete arch bridge carrying Jerome Avenue over Mosholu Parkway, were designed to conform to the special architectural treatment desired, including arched outlines for the concrete masking the steel girders, inlaid colored tile for surface treatment, and symmetrically placed stair houses with tower effects.

GENERAL LOCATION AND DIMENSIONS

Mosholu Parkway Station is located on Jerome Avenue between Mosholu Parkway south and Mosholu Parkway north, where the topography is undulating, including parks and driveways. Between the two parkways, Jerome Avenue is supported by a three-arch concrete viaduct, the center arch over a 60-ft. driveway and the two side arches over 14-ft. walks. The street level of Jerome Avenue is about 3 ft. above the crown of the center arch.

The station is 480 ft. long, symmetrically placed with respect to the arch viaduct, and supported on eight bents spaced 68 ft. 6 in. on centers, except that at the mezzanines and stair houses the spans are 55 ft. This spacing of about 68 ft. was adopted to bring the columns over the arch piers. Each bent consists of one 26-ft. center span and two side spans of 19 ft. 9 in., with four columns symmetrically placed about the center line of the avenue. The columns support outside longitudinal girders and cross-girders. The latter carry four interior longitudinal through girders 57, 60 and 69 in. deep. These through girders carry track floorbeams 30 in. deep, which support the three pairs of 20-in. and 24-in. I-beam track stringers spaced 5 ft. apart.

The width of the structure center to center of side columns, except at the mezzanines, is 65 ft. 6 in.; at the mezzanines the width is about 115 ft. 6 in. out to out

of walls of the stair houses. The distance from the street level to the base of rail is about 27 ft. 6 in.; to the under side of the outside girders the distance is about 25 ft. In order to conceal the interior girders, the bottom of the outer girders is at least 1 ft. below the interior girders. The height of structure from street level to top of platform roof is about 40 ft.

WIDE OUTSIDE COLUMNS—STAIR HOUSES RESEMBLE TOWERS

The outside girders and columns are of special lattice design to give the massive concrete sections desired, and at the same time to afford a thorough grip on the steel. These outside columns are 5 ft. 6 in. wide, with circular brackets at the connection to the outside girders, which are 94 in. deep. All the outside steel being covered with concrete, the structure has the appearance of a series of flat arches, as seen in the photograph. At the mezzanines all the girders and columns are covered with a minimum of 2 in. of concrete. Between the mezzanines and beyond for the remainder of the station only the outside longitudinal girders and columns are incased. To prevent cracking and loosening of this concrete from the steel, which might be caused by vibration due to train movements, or by shrinkage, the concrete is tied to the steel by rod mesh reinforcement.

Four reinforced-concrete stair houses, with tower outlines, about 27 ft. high above street level, are symmetrically located longitudinally and transversely about the center lines of the structure and 260 ft. apart on centers. The west and east walls of these stair houses, 56 ft. long, are offset about 25 ft. from the center line of the outside columns of the main structure and 8 ft. east and west from the street lines. Their lower portions act as retaining walls to support the ground, which at this point slopes away from the structure. The walls above the street level inclose the stairs leading to the mezzanines, ticket booths, waiting rooms, etc.

The tops of the stair-house walls, where the danger of cracking from temperature variations is the greatest, are reinforced by means of built-up I-sections,

which serve also to support the ends of beams carrying the roofs of the stair houses.

SHIELD WALLS HARMONIZE WITH STAIR HOUSES

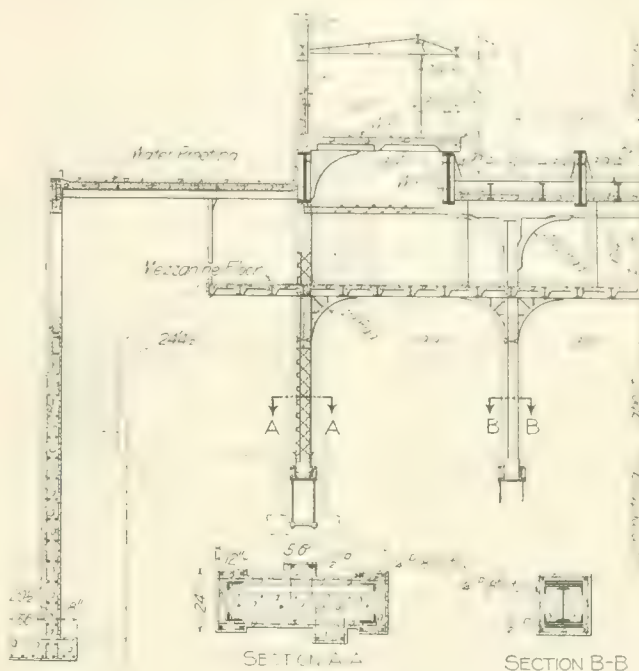
At the stair houses the platform shield walls are of reinforced-concrete construction extending from the roof of the stair houses to about 2 ft. above the roof of the platforms, and so designed as to harmonize with the tower features of the stair houses. These shield walls outside the mezzanines are of wood framing reaching from the platform to a sloping roof.

A transverse section through the station in front of the stair houses presents a view of an ornamental concrete structure supported on five flat arches. The structure over the roadway is about 9 ft. 6 in. deep, is supported on the three middle arches, and contains the mezzanines. The crowns of these arches, resting on four narrow concrete piers, are about 14 ft. above the street level. The span of the center arch is about 24 ft., that of the two side arches over the roadway about 18 ft. The extreme side arches over the sidewalks, of 16-ft. span, form the entrance to the stair houses. Alongside the main stair-house walls, and near the street lines, are provided eight retaining walls to support the sidewalks. These walls are finished on top with ornamental concrete fences to connect and harmonize with those of the concrete arch viaduct.

LOADING AND DESIGN ASSUMPTIONS

The live loading used for the design was a moving train of cars 52 ft. long on four-wheel trucks 36 ft. apart on centers loaded with 32,000 lb. per axle, increased for impact according to the well-known Public Service Commission formula. Platform and mezzanine live load was assumed at 100 lb. per square foot, including impact. The retaining walls were designed for a surcharge of about 4 ft. The earth pressure per square foot of wall was assumed at 33 lb. times the distance to top of surcharge.

The allowable unit stresses, as per the Public Service Commission's standard specifications, were decreased in some cases so as to avoid excessive deflection in the girders and thereby avoid injury to the concrete cover-



HALF CROSS-SECTION TAKEN THROUGH STAIR HOUSE

ing. Where steel framing covered with concrete was used, the steel was assumed to carry all the load, the concrete covering not being counted as taking stress.

EXPANSION JOINTS

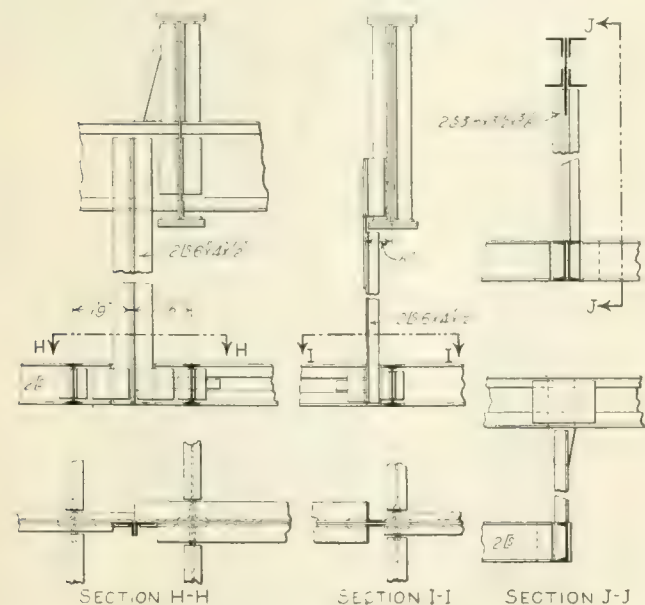
Four expansion joints are provided in the track floor steel, two just outside the ends of the middle span and two just inside the end bents. Only two expansion joints are provided in the outside longitudinal girders and platform roof, opposite the two middle expansion joints of the track floor.

The expansion joints in the outside longitudinal girders offered some difficulties, as it was objectionable to have an opening in the concrete exposed to view or to interrupt the architectural features of the exposed faces of the structure. These difficulties were overcome by attaching to the stiffeners of the girders at the expansion joints plates fitting the outlines of the structure and covering the gap in the concrete, as illustrated in one of the drawings. To conceal the difference in the appearance of the materials, the plates were painted to blend with the rest of the structure. The eight retaining walls alongside the stair houses are keyed in with the main stair-house walls by means of depressions filled with elastic cement, to allow for expansion.

WATERPROOFING AND RETAINING WALLS

In order to prevent water from leaking through the expansion joints in the walls and discoloring the exposed faces, three-ply waterproofing was placed at the joints on the faces of the walls in contact with the ground. Three-ply waterproofing was also used over the mezzanine roofs below the tracks and over the stair-house roofs, placed on top of concrete of 6-in. minimum thickness, and protected by a concrete slab of 4-in. minimum thickness.

All the walls, with their foundations, are of inverted T-sections. Their reinforcement consists of 1 1/4-in. deformed rods to resist the main stresses and 5/8-in. deformed rods to provide for temperature stresses. The



CONNECTION DETAILS—HANGERS FOR MEZZANINE FLOORBEAMS

Steel Construction Recommended for Chicago's Subway

Crossings of Two Tubes Over Illinois Tunnel Will Involve Incorporation of Latter in Floor System of New Structure

TYPICAL cross-sections and station layouts for Chicago's recommended subway system are presented by the Chicago Traction and Subway Commission in the supplement to its main report. The standard high-level subway section (for the elevated trains) is designed with roof beams spaced 5 ft. on centers, and with concrete jack arches between them to carry the street load. The roof beams are supported on columns between tracks and I-beam columns in the side walls. The commission states that experience in New York indicates this type to be generally preferable to a reinforced-concrete design, particularly where the construction is carried on under important business streets—it being more conveniently and quickly erected, as well as being more economical.

At station platforms the steel columns are spaced farther apart and sufficiently back from the edge of the platform to reduce interference with passengers loading and unloading from trains.

The structural features of the low-level subway (for surface cars) are identical with those of the high-level tube, except that heavier sections are employed to take care of the heavier loads. The floor construction may, in addition, include I-beam reinforcement to resist hydrostatic pressure where soft material and pockets are encountered.

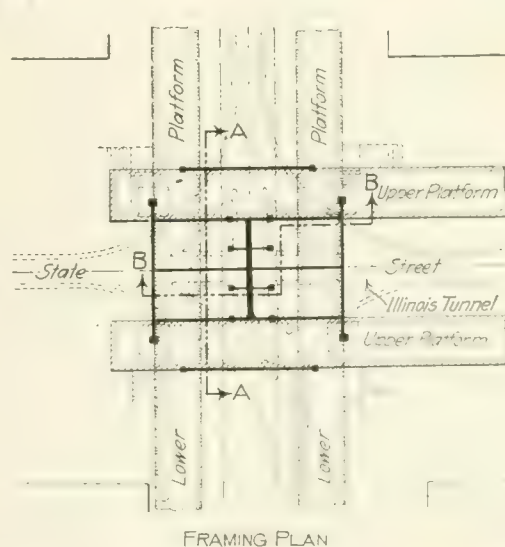
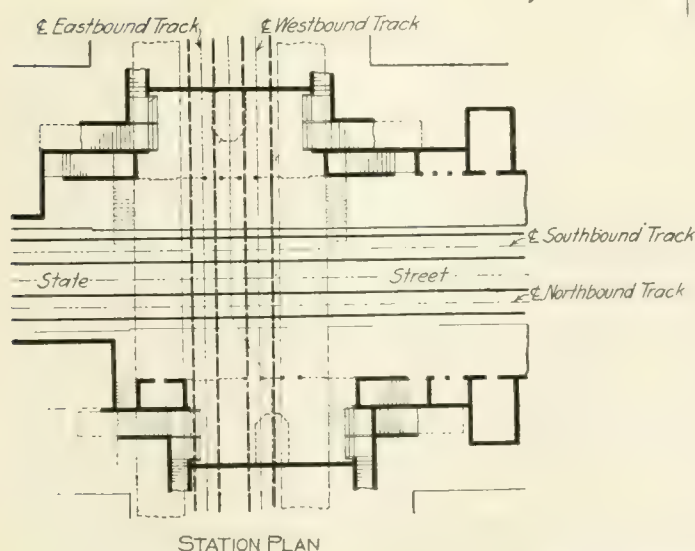
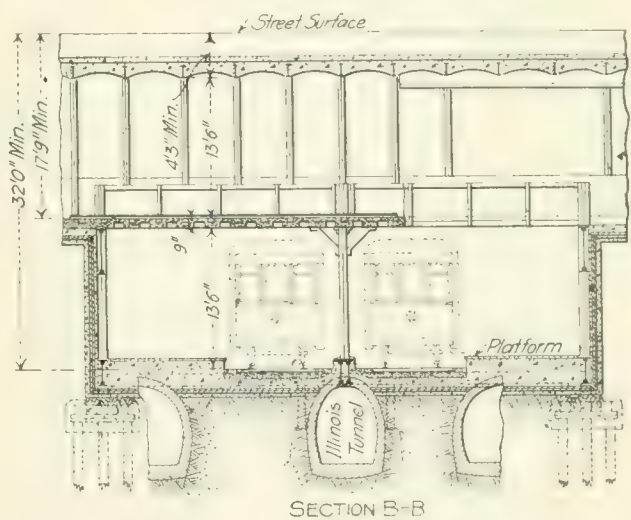
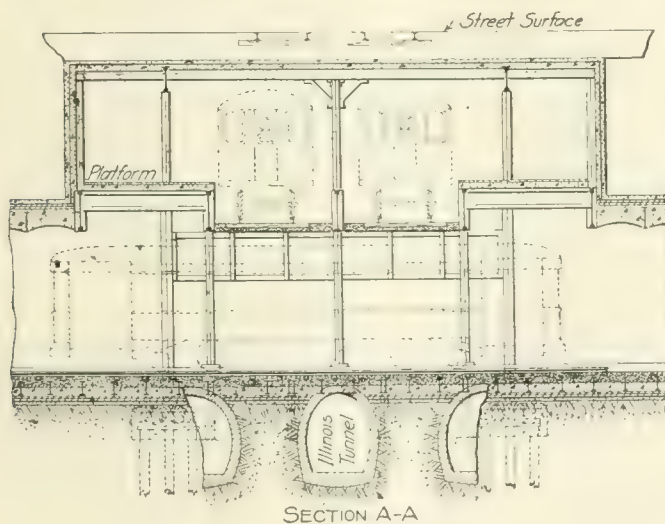
In general the stations are designed for ten-car trains, with platforms from 450 to 500 ft. long, with a minimum width of 12 ft.

WATERPROOFING AND DRAINAGE

Waterproofing is to be accomplished by enveloping the roof walls and floor with a membrane of woven fabric laid in pitch or asphalt mastic. In the low-level subway it may be necessary to waterproof the structure with bricks laid in asphalt mastic. All seepage is drained along the track to sumps, where electrically operated automatic pumps discharge the water into sewers.

In order to maintain proper ventilation, the tracks carrying traffic in opposite directions are separated by a curtain wall. The piston action of the train will be relied upon to push the air ahead and produce a suction behind the train, drawing the air in at the stations and expelling it at openings located between stations.

Between stations, standard track construction is rec-



CROSSING OF SUBWAYS OVER ILLINOIS TUNNEL ACCOMPLISHED BY INCORPORATING LATTER IN FLOOR SYSTEM

ommended with ties laid in rock ballast, placed in troughs of the subway floor. At stations unballasted track is recommended, the rails being laid on short tie pieces bolted to the concrete bed.

Perhaps the most complex problems of design come at the crossings of the two subways. The low-level subway for surface cars will pass under the State Street subway for elevated trains at two points. At both points the Illinois tunnel (for small freight cars) occupies both streets, crossing at grade and being provided with Y connections. In order to get sufficient headroom in both passenger subways, and also to allow a sufficient deck to carry the street, it will be necessary to incorporate the Illinois tunnel in the floor of the low-level subway. The illustration shows how this can be done.

William Barclay Parsons, Robert Ridgway and Bion J. Arnold constitute the Chicago Traction and Subway Commission.

Funding Company to Promote Water Sales and Sanitation

Installment Plan of Payment for Water and Sewer Connections Modeled After That Used by Gas and Electric Utilities

A PARTIAL-PAYMENT plan for the installation of plumbing fixtures, water and sewer connections has been proposed for Indianapolis. Only two-thirds of the city is now so supplied, and the remaining business looks tempting to the water-company officials. While the failure to provide an easy means of financing sanitary improvements by the poorer classes may not be charged up entirely to the sanitary engineer, it is doubtless true that he would often see quicker returns in decreased typhoid rates, following the construction of municipal sanitary works, if he would pay more attention to working out a practical way by which the small householder can avail himself of a good water-supply and sewerage system. Statistics gathered by the Public Health Service indicate that the Indianapolis percentages of population without sanitary conveniences are not far from the average; therefore the following abstract of a paper presented recently to the Indiana Sanitary and Water Supply Association by R. A. Butler, publicity expert, and F. C. Jordan, secretary, of the Indianapolis Water Company will apply quite generally.

MAKE SANITATION EASIER

Analyses of the ownership of property in Indianapolis that is not modern reveal a condition contrary to the popular view. Small properties that lack modern sanitary equipment are not held by grasping big business men. They are owned either by those who are struggling to make investments at the ratio of rent or by the moderately well-to-do who have invested their all in one rental speculation and have not the additional capital with which to improve their holdings. These people are good credit risks. They have shown their thrift in the purchase of their properties and they are able to qualify by the moral standard that financiers now say they consider most thoroughly in making loans.

Yet no one has gone into the business of making it easy for them to care for their health. No one has offered to them the advantages now offered to the man

of moderate means who would own a touring car. The opportunities of financing modern sanitary necessities have long been neglected.

Why not make it possible for the man who owns a small property to have sanitary plumbing installed in his home and the cost thereof extended over a reasonable period? Electric-light companies are wiring homes for electricity on this theory. Gas companies are installing ranges on payments. They have the sales and the collection systems already in operation, and the addition of appliance accounts is simple and involves little cost. The manager of the Peoples Gas Light & Coke Company, of Chicago, recently asserted that the greater agency of development in the gas manufacturer's field to-day was the partial-payment plan of selling appliances. His company has more than 600,000 of these partial-payment accounts on its books.

This same method of financing can and will be applied to water service and modern sanitary improvements in the near future. It is a problem that confronts water companies all over the country, and it is a solution that means more services on their mains, the use of more water and the improvement of the health of whole communities.

APPLIES TO MUNICIPALLY OWNED PLANTS TOO

Whether or not water companies or municipally owned waterworks systems embark in the plumbing business directly or indirectly is a matter of small moment and local conditions. The water utility that undertakes plumbing as a side issue for the purpose of intensifying its patronage will encounter difficulties in the way of criticism. It may be denounced as a grasping corporation seeking to establish a trust in the plumbing business. But the fact remains that, because of its buying power, its credit and the ability to wait for its profit and take it in increased water consumption, it will be able to give to the property owner more satisfactory plumbing at less cost than it can now be obtained.

But even for the water utility that is restricted as to business by its charter or its ownership, there is no great difficulty in the partial-payment plan.

PRESENT AND POSSIBLE BUSINESS

In Indianapolis there is an outlet from the mains of the water company for every 7.5 persons in the city. The average size of a family is five. It follows that the business of the water company is 33 1/3 per cent less than it might be. This one-third represents the field of prospects, and any merchandising expert will say that one-third of the whole of a city's population is a desirable field to cultivate. With one-third of the city as the field, there is necessary, to the development of business, capital sufficient to equip the possible user of water for its enjoyment. The installation desired in the class of homes in the city, that now have no water service, has been estimated at a physical cost of from \$100 to \$250, according to size and location. Taking the lowest figures as a basis, interest at 6 per cent for two years and a brokerage charge of 6 per cent could be added, and the installation made at a partial-payment cost of \$4.92 a month for twenty-four months. To this should be added the cost of water, not exceeding \$1 a month, making in all a charge against the property of

\$5.92 a month, or approximately 19.7 cents a day. This should prove a fairly attractive proposition for the man with a small property whose concern is a safe water supply such as is furnished by water utilities. Other advantages, such as baths and toilets, will follow quickly on the heels of the first installations, and their costs will be relatively small.

Brokerage charges should be no greater for the large installation than for the small, if based on cost, but policy might dictate a sliding scale in order that first costs of installation be reduced.

FUNDING COMPANY SUGGESTED

The organization of a funding company with capacity to handle this business should not be difficult. Capital would, of course, demand an ample margin of security, but it is the opinion of legal authorities that this security could easily be provided.

Organization and operation of the funding company are possible at a very small overhead cost. The amount of capital actually necessary is dependent on the size of the field, but a consideration not to be overlooked is the fact that each month brings part of the capital back for reinvestment and with each monthly payment the individual account becomes more secure.

Operating expenses of the funding company would consist of three branches—promotion of business, investigation of risks, and collection. The expenditure necessary for the promotion of business will depend on the method of operation finally adopted.

Investigation shows that the great cost involved in installations such as are under consideration is not the plumbing but the sanitary sewer, the very thing that sanitation demands. This cost is not one of material but of labor, and probably no one plumber has any advantage over another in doing it. Plumbing is largely a matter of labor, and in most communities is so restricted by ordinance that it must be made standard. Fixtures furnish the greatest opportunity for cost reduction by purchase in bulk, but there are other advantages to be considered in determining whether a funding company should work in conjunction with all local plumbers or take over plumbing as a part of its business.

MAKE PLUMBERS BOOST

In the automobile business it has been found more desirable to have the funding company separate from the sales agency, in name at least. Perhaps this would be more advisable in sanitary funding. Certain it is that if the funding company were holding out to each plumber an opportunity to do work and collect his money immediately, even though the employer is not in a position to pay him cash, every plumber in the community would become an enthusiastic salesman and the cost of sales would be greatly reduced for the funding company.

The ideal situation seems to involve the organization of a company with sufficient capital or financial backing to be able to say to the property owner, "Hire any plumber you choose and select any fixtures you desire. We will pay the entire cost and give you two years in which to repay us."

Then, with the plumbers of a city the enthusiastic boosters of the funding company, the examination of

the risks is the next important operating detail. It has been estimated that this work can be accomplished at a minimum fee of \$5 a risk. The burden of showing title to the property is to be thrown on the applicant for a contract, and extensive investigation is not necessary. A manager of ordinary intelligence would be capable of judging the advisability of the contract and a single inspection of the property should be sufficient to satisfy him. The time element is not important and his work could be so distributed as to make it least expensive.

COLLECTION PROBLEM EASY

For convenience of collection the water rental and the partial-payment should be payable at the same place, the lessee being billed for the total and the utility holding the funding company responsible for the water rental. A simple card system of bookkeeping and a stenographer supplied with suitable letter forms for prodding the delinquents should accomplish the collections without great expense.

Whenever it is possible for the small property owner to improve his property without shouldering a hardship in the form of a big initial expenditure, it will be easier to insist on sanitary improvements. The greatest argument against the condemnation of open vaults and unsafe wells will disappear. Laws designed to wipe out these breeders of disease will not be assailable on the grounds that they are confiscatory. Property owners will benefit by increased value of their holdings. Renters will find properties more desirable. Water utilities will cut down their fixed charges as they increase the number of their patrons. Improved sanitation will bring about better health and there will be far more individual effort toward community health.

Good Roads Are Increasing in Cost

The Michigan State Highway Department recently reviewed its work during the last ten years and discovered some instructive figures of the increase in cost of road building during this period. These figures have just been made public by the American Highway Association. The state has large, widely distributed deposits of good gravel for road-building, and many miles of gravel roads have been built. In 1905 the average cost of this gravel was 12 cents per cubic yard; to-day it is about 30 cents per cubic yard at the pit. In 1905 ordinary labor was paid \$1.75 to \$2 per day, and \$3 per day was paid for team hire; to-day ordinary labor is paid \$2.25 to \$3 per day and a team costs \$5 to \$6 per day. The state has also built many miles of macadam roads in the last ten years, and they have been increasing in cost like the gravel roads. In this case the increase has been mainly due to the mounting charge for labor, because the cost of broken stone has increased only from \$1.30 to \$1.50 per cubic yard. From these figures the conclusion is drawn that it is more important than ever before to employ labor and materials in the best manner, for inefficiency and carelessness now mean a larger waste of public funds than when prices were lower. A competent road builder now saves his salary many times over by stopping the leaks that occur under incompetent supervision, however honest it may be.

Brush Mattresses Floated from Sloping Platform

Rockfill Sinks Mats After They Are Launched to Protect Channel Bank on Stuck-Puyallup Project, Near Seattle

THE NEW CHANNEL dredged for the Puyallup River in the Stuck-Puyallup improvement project near Seattle, described in the Engineering Record of Nov. 11, 1916, page 587, required that the banks be protected from current and wave action, particularly along the lower stretches. The revetment work was divided into two parts—the subaqueous brush mattress and the concrete paving above low-water level. Both operations were carried on from barges.

To facilitate the construction of the brush mattress, which is 40 ft. wide and about 6 in. thick, a sloping platform was built on the deck of a barge. This was called a "catamaran." By advancing this catamaran downstream, the completed portion of the mattress readily floated off the platform, making way for the construction of another length. By this method joints were avoided.

Two 1¼-in. cables were run through the mattress and seven longitudinal lines of poles were stitched into

After being floated and the shore end fastened in place, rock ballast was dumped on the mattress. This was delivered on scows ranging in capacity from 100 to 200 tons, at \$1.85 per ton. The amount of ballast used and the costs for ballasting 6245 ft. were as follows: 0.547 ton per foot at \$1.85 per ton, \$1.01; labor, 18 cents; depreciation, tools, etc., \$0.029; total per linear foot in place, \$1.219.

Having finished the work on the brush mattress, another barge, on which was mounted the concrete-mixing equipment, was towed along the shore and a 4-in. concrete pavement placed on the slope between the brush



WEAVERS AT WORK—UPSTREAM SIDE OF SLOPING PLATFORM

mattress and the top of the bank. The scow carried a 10-cu. ft. Smith mixer operated by a gasoline engine. The materials were delivered on barges brought to the stream side of the mixer barge.

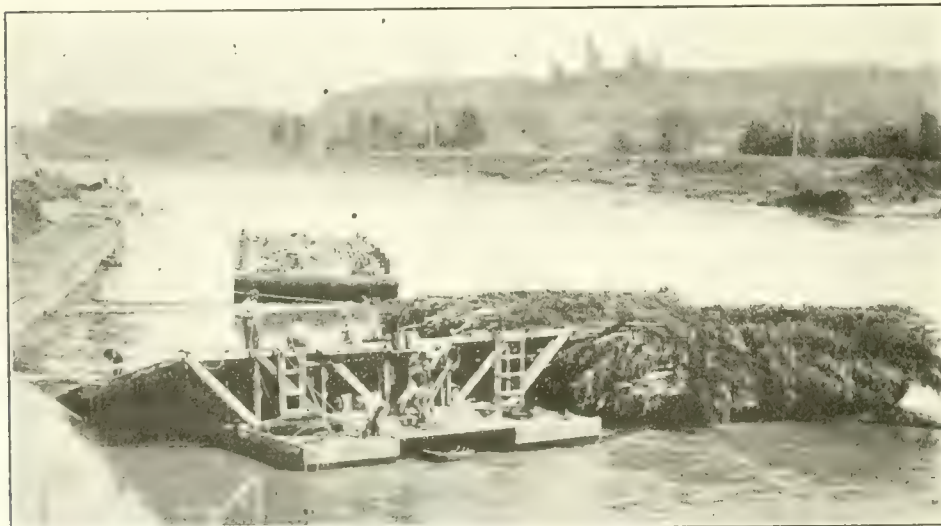
The price of cement delivered on the work was \$1.76 per barrel; gravel, \$1.15 per cubic yard; and sand, \$1.15 per cubic yard. The mix was 1:3:6. The average cost of the concrete was \$5 per cubic yard in place, or 55 cents per square yard.

The work was carried out under the direction of W. J. Roberts, chief engineer of the Inter-County River Improvement.

COST OF MATTRESS PER LINEAR FOOT

6-in. by 40-ft. brush (0.345 cord per foot) at \$2.20 per cord	\$0.76
Wire, nails, staples	.067
Cable	.043
Labor	.369
Depreciation and tools	.039
Rental, towage, demurrage	.007
Total per linear foot in place	\$1.285

it at 6-ft. intervals with No. 6 annealed wire. The brush for the mattress was delivered on scows at \$2.20 per cord and the cost per linear foot in place of 6245 lin. ft. of the mattress was as given in the table.



BARGES OF BRUSH WERE TOWED ALONGSIDE CATAMARAN

Panama Canal Costs Are Double Revenue

Including the 1253 ships making the transit in 1916, the total number of ships which used the Panama Canal in the time from its opening in 1914 to Jan. 1, 1917, was 2780, according to the *Panama Canal Record*. Their gross and net canal tonnages were 13,086,535 and 9,209,503 respectively. The total quantity of cargo which was carried through the canal was 11,652,405 tons. The number of ships passing through the canal in 1916 exceeded by 83 the number (1170) making the transit in the year 1915. The aggregate revenue from tolls for the year 1916 was \$3,677,695.60. The cost of operation and maintenance for the same period was \$7,142,124.05.

How to Determine the Annual Unit Cost of Pavements

W. H. Connell Analyzes Conditions Under Which One Type of Pavement Is More Economical Than Another

THERE has been considerable discussion relative to the advisability of paying the entire cost of repaving out of current taxes. Such a method of financing, of course, would result in a lower annual cost to the city because there would be no loan interest charges to pay, it being necessary only to set aside a certain sum annually as a sinking fund to replace the pavement at the end of its economical life. While this method results in adding to the city's assets by providing a wider margin of debt limit and in lessening the carrying charges, it is nevertheless the more costly method of financing for the taxpayer, according to William H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, from whose paper before the recent meeting of the American Association for the Advancement of Science the following matter has been taken.

THE TAXPAYER AND HIS MONEY

If repaving be paid for out of current taxes and it cost the taxpayer \$100 for his share, he would lose the use of this money. If, however, he elected to pay an annual amount equal to the interest and sinking-fund charges to redeem a bond running for a term theoretically equal to the economical life of the pavement, the taxpayer could deposit this \$100 in a savings bank. At 4 per cent compound interest it would amount to \$219 in 20 years, while the total annual interest and sinking-fund charges, based on the bond-issue method of payment, would amount to only \$147 in the same length of time. This would be \$72 less than the sum accumulated at compound interest on his original \$100, and represents a saving of just that amount.

As all communal governments should be conducted in the interest of the people, it would seem that the cheaper method of financing for the taxpayer is to pay annually the interest and sinking-fund charges on loan funds for the period of the economical life of the pavement. He thus secures the advantage of being able to invest, at compound interest, funds equal in amount to the original cost of the pavement.

PAVEMENTS ONLY PART OF FINANCIAL BURDEN

In discussing the methods of financing pavements, it should be borne in mind that they constitute only a part of the necessary structures or improvements upon which a communal scheme of financing is based. In other words, the terms for which the bonds are sold may be based on the average economical life and proportionate values of all classes of structures. An illustration of this is given in the following quotation from the 1915 report of John M. Walton, comptroller of the city of Philadelphia:

"Life of City Property—The question has been raised as to the propriety of including short-lived equipment in the property account, and of buying equipment that will last but a few years out of thirty-year bonds. I believe that your procedure in this regard has been a perfectly safe one in the past and consider that a con-

tinuance of such practice is safe so long as the expenditures of loan moneys for improvements that will last considerably in excess of thirty years greatly outweigh, as at present, the inconsiderable expenditures of loan moneys for short-lived equipment. Annual estimated depreciation in 1915 and subsequent years is and will be charged to expense, so that the current revenue of each year will have to bear its fair share of burden for depreciation on property and equipment and the resulting operating deficit or operating surplus will show clearly whether current revenues are sufficient to meet all the expenses of the year, including upkeep and replacement of the city's property and equipment.

"The average life of each dollar's worth of city structures, non-structural improvements and equipment at present is 60.62 years. Taking the property and equipment separately, the average life of each dollar's worth of structures and non-structural improvements is 62.72 years; while the average life of each dollar's worth of equipment is 21.92 years. The fact that the average life of the equipment and property combined is only 2.1 years less than the average life of the structures and non-structural improvements apart from the equipment is owing to the fact that the city, for every dollar that it has invested in its equipment, has \$18.50 invested in its structures and non-structural improvements."

CONSIDERATION OF ANNUAL UNIT COST

There are many considerations entering into the determination of a financial policy. It would appear, in a general engineering discussion, that the annual unit cost should be considered as the annual interest and sinking-fund charges on term bonds, or the annual cost on serial bonds to redeem a proportionate amount of the loan each year, extending over a period equivalent to the theoretical economical life of the pavement; to this should be added the annual maintenance costs.

The accompanying table gives a general idea of the first costs of the different types of pavements and their costs per square yard per year. Figures are given for various methods of financing and for various terms of payment.

LIFE OF BASE AND SURFACE CONSIDERED SEPARATELY

The consideration of the mathematical mean economical life of the base and surface courses is desirable in a general discussion of the economical life of pavements and their costs. The figures in column D of the table represent the mathematical mean economical life of each type of pavement based on the estimated economical lives and relative costs of the base and surface courses.

The maintenance cost values and the estimated economical life given in the table are only approximate, are based upon average conditions, and are not intended to represent definite data applicable to any city or locality. The actual maintenance costs of pavements cannot be determined until some of the cost data records now being kept have extended over a period of years equivalent to the economical life of the several types of pavement. In the meantime certain assumptions will have to be made, based upon research and the experience and judgment of highway engineers. It should be borne in mind, however, that a similar procedure was necessary in the infancy of life-insurance companies and other similar undertakings.

That each of these different types of pavements is usually constructed to meet specific traffic conditions should be taken into consideration. For instance, a granite-block pavement on a concrete base, costing \$0.1732 per square yard per year, would be constructed for heavy traffic, whereas a bituminous pavement on a broken-stone base costing \$0.1569 per square yard per year would be used on a suburban or country road carrying comparatively light traffic. Likewise, concrete and bituminous pavements, while they may show a higher annual cost than waterbound macadam, are

adaptable for traffic conditions where waterbound macadam would not be suitable. The following data are given to illustrate the comparative costs of three extensively used types of pavements subjected to similar traffic and other conditions:

Character of pavement	Estimated mathematical mean economical life of base and surface courses	Estimated first cost	Total annual cost
Sheet asphalt	17	\$1.90	\$0.1862
Wood block	20	3.00	.2507
Granite block	40	3.45	.1851

Annual Costs of Financing Pavements on Loan Funds, Plus Estimated Maintenance Costs

City Street Pavements											
A	B	C	D	E	F	G	H	I	J	K	
SHEET ASPHALT:											
6-in. concrete base course	\$0.85	40									
1 1/2-in. surface and 1-in. binder courses	1.05	17	23	\$0.03	\$0.2231	\$0.1740	\$0.1324	\$0.1592	\$0.1506	\$0.1579	
VITRIFIED BLOCK:											
6-in. concrete base course	.85	40	19	.04	.3688	.2851	.2129	.2448	.2325	.2417	
4-in. surface and 1-in. sand cushion courses	1.80	15									
GRANITE BLOCK:											
6-in. concrete base course	.85	40	36	.005	.2181	.1603	.1012	.1748	.1555	.1732	
5 1/2-in. surface and 1-in. sand cushion courses	2.60	34									
WOOD BLOCK:											
6-in. concrete base course	.85	40	24	.03	.3296	.2534	.1887	.2311	.2150	.2267	
4-in. surf. and 1-in. 1:4 cement-mortar cush'n c'ses	2.15	20									
ASPHALT BLOCK:											
6-in. cement concrete base course	.85	40	18	.06	.3755	.2951	.2271	.2544	.2452	.2535	
3-in. asphalt block surface and 1-in. 1:4 cement-mortar cushion courses	1.60	14									
BITUMINOUS:											
6-in. concrete base course	.85	40	26	.05	.2574	.2046	.1598	.1828	.1760	.1824	
1 1/2-in. surface and 1-in. binder courses	.95	14									
BITUMINOUS:											
6-in. concrete base course	.85	40	17	.05	.2624	.2083	.1625	.1792	.1722	.1774	
2-in. surface course	.70	10									
Suburban and Country Roads											
BITUMINOUS:											
6-in. concrete base course	.70	40	20	.05	.1845	.1428	.1101	.1353	.1265	.1332	
1 1/2-in. surface and 1-in. binder courses	.95	20									
BITUMINOUS:											
6-in. concrete base course	.70	40	20	.04	.1893	.1514	.1190	.1384	.1316	.1369	
2-in. surface course	.70	15									
BITUMINOUS:											
6-inch broken stone base course	.60	20	15	.04	.2456	.1932	.1489	.1588	.1527	.1569	
2-in. surface course	.70	12									
BITUMINOUS:											
6-in. broken stone base course	.60	20	14	.04	.2497	.1961	.1516	.1581	.1497	.1536	
3-in. penetration surface course	.60	10									
CONCRETE, REINFORCED:											
6-in. concrete course	1.45	20	20	.04	.2087	.1658	.1294	.1467	.1415	.1467	
WATERBOUND MACADAM:											
6-in. telford base course	.50	20	15	.06	.2152	.1756	.1421	.1505	.1468	.1499	
4-in. broken traprock surface (course bituminous surface treated)	.50	10									
WATERBOUND MACADAM:											
4-in. broken stone course	.50	20	14	.06	.2246	.1901	.1524	.1584	.1514	.1547	
4-in. broken traprock surface (course bituminous surface treated)	.50	10									

A. *Character of Pavement*—Only the more extensively used types of constructions have been considered. Each pavement has been subdivided into its two component parts—namely, base course and surface course, for consideration separately with respect to estimated first cost and economical life.

B. *Estimated First Cost*—The indicated values are arbitrarily based upon the approximate average unit prices prevailing during the past several years. Where necessary, due allowances should be made, however, in specific localities and at such times as the current market prices of labor and materials make revisions necessary.

C. *Estimated Economical Life*—The estimated economical life values are based upon the assumed life of the base and surface courses respectively of the different types of pavements under the average traffic conditions for which each specific type is best suited.

D. *Mathematical Mean Economical Life*—The indicated mathematical mean economical life figures are empirical values. They were derived by the following method: If the annual sinking fund charges for the base and surface courses are added together, this sum taken as an annual sinking fund charge will at the end of a certain period of years accumulate an amount equal to that of the total unit cost of the pavement. This period of years, which may be interpolated from a sinking fund table, is considered to be the mathematical mean economical life of the pavement.

E. *Maintenance*—The indicated annual maintenance costs include such repairs as are necessitated by service wear and the application of bituminous surface treatment to waterbound macadam pavements.

F, G, H, I, J, K. *Ten, Thirty and Fifty-Year Bonds*—The costs under term bonds for periods of 10, 30 and 50 years respectively include the sinking-fund charges (based upon the assumption that a sufficient sum be set aside each year and invested to earn 4 per cent compound interest, which fund plus the earned interest will amortize the face value of the bond at its maturity, and the total

net amount thus paid into the sinking fund is prorated in equal annual charges over the entire economical life of the base and surface courses respectively), plus the interest on the loan funds (which is the total amount of interest at 4 per cent per annum paid during the term of the loan, prorated in equal annual charges over the entire economical life of the base and surface courses respectively), plus the annual maintenance costs.

I. *Economical Life Bonds*—The costs under economical life bonds include the annual sinking fund and interest charges on two bonds extending for terms equal, respectively to estimated economical life of the base and the surface courses, plus the annual maintenance costs.

J. *Serial Bonds*—The costs under serial bonds include the annual proportional part of the original loan fund extending for a period equal to the mathematical mean economical life of the pavement, which is redeemed each year by installment payments, plus the interest on the unpaid balance of the loan fund, plus the annual maintenance costs.

K. *Mathematical Mean Economical Life Bonds*—The costs under mathematical mean economical life bonds include the average annual sinking fund and interest charges on a bond extending for a period equal to the mathematical mean economical life of the base and surface courses, plus the annual maintenance costs.

1. *Concrete Base Courses*—The economical life of the concrete foundation courses has, in all cases, been based on the assumed necessity of replacement due to its condition caused by openings and other causes.

2. *Salvage of Old Granite Blocks*—At the expiration of the economical life of the surface course of the granite block pavement, the old blocks have a salvage value of 50 cents a square yard, which value has been prorated over the economical life and is deducted in the indicated annual costs.

3. *Ten-Year Bonds*—The 10-year bonds, while less costly to the city than bonds running for the estimated economical life of the pavement, are, however, more costly to the taxpayer, as they require a greater outlay each year.

It will be noted from the table that two asphalt pavements may be constructed for less than the cost of a granite-block pavement, but from the standpoint of convenience to business interests and the general public a granite-block pavement may ultimately prove to be the less costly due to the fact that it will be unnecessary to disturb the pavement during its economical life.

There are a number of very heavy traffic streets in the business sections of such cities as New York, Chicago, Philadelphia and Boston, where a sheet asphalt pavement would last not more than seven years, while a granite-block pavement would last seventeen years. The cost data given below are for situations of this character, traffic and other conditions being similar.

The total annual cost of granite-block pavement as indicated in the table below includes a deduction of \$0.0294, which represents the salvage value of the old

Baltimore & Ohio Opens New Coal Pier at Baltimore

Plant Consists of Low Wharf Carrying Moving Belts and Traveling Towers Instead of Usual High Superstructure for Cars

THE NEW coal pier of the Baltimore & Ohio Railroad at Curtis Bay, near Baltimore, has been put into service. Besides having what is believed to be the largest capacity of any coal pier in the world—12,000,000 tons per year or 7000 tons maximum per hour—the plant marks an entirely new departure in coal terminals. Instead of the usual high structure, to which railroad cars are by one means or another elevated, being then emptied into bunkers from which chutes lead to the vessels alongside, this plant consists of a



NEW COAL TERMINAL AT BALTIMORE HAS LITTLE RESEMBLANCE TO OTHERS ALONG ATLANTIC SEABOARD

granite blocks at the expiration of the pavement's economical life prorated in annual deductions over the economical life of the pavement.

ANNUAL COST OF CLEANING

The cost of cleaning varies with the type of pavement, and there are many considerations entering into these costs, such as the difficulty of cleaning on account of congestion of traffic, width of street, state of repair of pavements, and in block pavements whether

Character of pavement	Estimated economical life in years of base surface	Estimated first cost of base surface	Maintenance charges	Interest and sinking fund charges	Total annual cost
Sheet asphalt...	10 7	\$0 85 \$1 05	\$0.06	\$0.2178	\$0.2778
Granite block...	40 17	85 2 60	03	.2566	.2572

or not they are modern pavements with grouted joints, etc. The average cost of cleaning for all types of pavements, based on the costs of several representative cities, is approximately 10 cents per square yard per year. From this it will be noted that the cost for cleaning is practically double, and in some cases more than three times the annual cost of maintenance repairs.

In Austin It Pays to Think in Advance

The city of Austin, Minn., has an ordinance imposing a penalty of \$50 for opening a pavement for a new water, gas or sewer connection that has to be laid after the pavement is completed. This does not apply to necessary repairs.

pier with a concrete deck 8 ft. above mean tide, on which the coal is handled by moving belts and traveling towers. One of the advantages claimed for the new design is the overcoming of breakage of the coal.

At the shore end of the pier are two car dumpers, equipped with special movable aprons to ease the fall of the coal and prevent breakage. Each dumper feeds three belts 60 in. wide, with a capacity of 2000 tons per hour and a speed of 500 ft. per minute. Two in each group run out on the pier to the loading tower. The third of the group runs to what is known as the balancing bin.

LOADING AND TRIMMING TOWERS

For each dumper there are two loading towers and a trimming tower. Each loading tower is equipped with a cage supporting a shuttle ram. The cage is raised or lowered to suit the height of the vessel being loaded, thus providing further precaution against breakage of the coal. The cage has a variation of height of 27 ft., the minimum height above the water being 15 ft. The shuttle ram, which can be run out on either side of the pier, has a maximum reach of 45 ft. With the towers traveling along the pier in a horizontal direction and the shuttle working in and out at right angles, this apparatus will load a hatch uniformly and reduce trimming to a minimum.

The two trimming towers, located on either side of the pier, have belts 48 in. wide, with a capacity of 1500 tons per hour when traveling at a speed of 500 ft. per minute. Coal for them is taken from the balancing bin. The towers have swinging booms 45 ft. long. They are attached at their base to turntables and can be moved in

a circle on a horizontal plane. They have a vertical variation of 35 deg. each way from the horizontal.

While the loading towers are working on the cargo, the trimming towers are loading the bunker coal. After the loading towers have finished their work, the trimming tower finishes the slow work of the vessel, thereby releasing the loading towers to work on another vessel.

In running the pier at maximum capacity, the operation of the car dumpers must not be interrupted; hence when it becomes necessary to stop a loading tower to shift it to another hatch the coal is placed temporarily in the balancing bin. From there it is taken by either a loading tower or a trimming tower and placed in the vessel.

ELECTRIC CONTROL

The functions of the pier are interlocked and controlled electrically with push buttons located every 20 ft. on each belt-conveyor runway. By pushing a button all movable parts of the belt, tower and feeders are stopped. The operators are located in houses on the shuttles. They first start the shuttle belt, and when this is running at full speed the main belts automatically start, and when at full speed the feeders also start automatically.

The shuttle belt is run at a greater speed than the main belt, the main belt running faster than the feeders, so that there is no danger of flooding the main or shuttle belt. A master control of the pier is located in the superintendent's office, enabling him to establish the maximum speed at which the belts are to run.

The pier, which was begun in February, 1916, cost \$2,500,000. It was the conception of M. A. Long, architect and assistant to the chief engineer for the Baltimore & Ohio Railroad, and was carried out under the direction of Francis Lee Stuart and R. N. Begien, former and present chief engineer respectively.

Some Ethical Questions Answered

Actual or Hypothetical Situations Are Treated by Special Committee of American Institute of Consulting Engineers

THE American Institute of Consulting Engineers has established a custom, similar to that of the Bar Association, of answering ethical questions presented to it, based upon facts coming under the notice or practice of engineers, or upon hypothetical situations. The questions are handled by a special committee intrusted with this work, and upon adoption by the council it is ordered that those of particular materiality be printed and published for the benefit of the profession generally.

The first series of these questions, together with the approved answers, have just been issued and are here given in a condensed form. Additional cases will be published from time to time as occasion seems to warrant.

1. *Question*—Is it proper or wise on the part of A to accept responsibility without personally investigating or verifying the accuracy or adequacy of surveys and data supplied by B?

Answer—It would be unwise for A to proceed without personally satisfying himself of the adequacy and

accuracy of the data supplied by B, unless it were distinctly understood or stated in the terms of A's engagement that he should assume no responsibility for the correctness of the data supplied to him. Such review and verification is desirable in order to protect both the client and the engineer from the consequences of erroneous data or misunderstood conditions.

2. *Question*—Would it be unethical for an engineer to accept and act on the proposition of a patent attorney to solicit or turn over legal work to him on a fee-sharing basis?

Answer—The sharing of fees or profits as compensation for soliciting engagements is regarded among engineers as unethical. This does not apply to the division of fees in cases where two or more engineers are jointly employed or engaged upon the same work.

USE OF NAMES AS REFERENCES

3. *Question*—Is it unethical for engineers to permit the use of their names as references in business enterprises, or for the promotion of business schemes?

Answer—It is regarded as at least imprudent for an engineer to permit the use of his name as a reference regarding the character and responsibility of persons or business concerns for advertising purposes. The practice might lead not only to personal embarrassment but to the discredit of the profession.

4. *Question*—Is an engineer entitled to claim and receive the whole amount of the fee which would be due him if work suspended for good reason had gone on to completion?

Answer—Such contingencies should be provided for in the original agreement between engineer and client. In the absence of such a provision, and unless the circumstances should warrant a different action, and particularly where the abandonment occurs through no fault or bad faith on the part of the client, settlement upon an equitable basis for the work already done, and the expenses and obligations already incurred, would be fair and just to both parties.

PUBLIC COMPETITIONS

5. *Question*—Should engineers recognize or take part in such public competitions for services where it is to be presumed that the lowest bidder will be engaged for the services?

Answer—It is not regarded as ethical for reputable engineers to enter such competitions. This does not, however, apply to competitions for designs for a specific structure where such competition is properly conducted and provision is made for reasonable compensation for rejected designs.

6. *Question*—If in the course of an investigation an engineer makes discoveries which, while foreign to the subject of his specific engagement, are so related to the business of the client as to be of great importance to him and, if disclosed, might seriously affect that business, does the present ethical relation of the engineer to his former client permit him to develop these discoveries for his personal use or profit, or to publish an account of them in the interest of science?

Answer—The engineer should not make use of information or discoveries, or the results therefrom, obtained while in the service of a client, in any manner adverse to the interests of the client.

Nomographic Chart Simplifies Column Design

Values for Required Area, Length Ratio and Average Unit Stress Easily Obtained When Length and Radius of Gyration Are Known

By CHARLES D. CONKLIN, JR.

Cooper Union, New York City

SUPPLEMENTING the articles describing methods of constructing nomographic charts and examples of their application in the Engineering Record of June 26, 1915, pages 807 and 809, there is here given a chart which will aid the structural designer in selecting sec-

scale, and the desired value of 16 sq. in. for the area A is read on the other inclined scale. If desired, the average unit stress is easily read as 8800 lb. per square inch on the outside of the right vertical scale.

If it be desired to investigate a given column of known area and properties, the procedure is the same except that the second line connects with the known area A and gives the desired allowable total load P on the outside of the left vertical scale. Any other straight-line column formula can readily be charted in a similar manner.

Largest Reclamation Pumping Plant in Country Constructed

Pumps Designed to Meet River-Flood Conditions in Solving California Problem—Six 800 Horse-power Units Required

THE LARGEST reclamation pumping plant in this country, requiring six 800-hp. motors, each driving a 50-in. centrifugal pump, has been recently constructed in California. Each pump has a normal capacity of 175 sec.-ft. against a discharge head of 29 ft. The design of this plant, including the method used in estimating the amount of drainage water and the resultant plant capacity, is described in a paper entitled "The Design and Test of a Large Reclamation Pumping Plant," recently presented by G. C. Noble before the American Society of Mechanical Engineers.

DISTRICT SUBJECTED TO FLOODS

The reclamation district, known as Sutter Basin, is located in the Sacramento Valley, at the junction of the Sacramento and Feather rivers, and is so situated that it is subjected to the flood waters of both. An extreme length of approximately 19 miles and a maximum width of 10 miles give an area of approximately 66,000 acres. The lowest point, which is located near the center of the basin, has an elevation of 10 ft. above datum, while the maximum elevation is 30 ft. above. In winter, with a maximum flood elevation of 39 ft. above datum, the entire district is submerged to a possible depth of 20 ft. To cope with these flood conditions a levee, 70 miles long, was designed for the entire circumference. As the natural drainage is toward an existing slough, emptying into the Sacramento River near its junction with the Feather, the pumping plant was located at a point where this slough was to be crossed by the levees.

SOURCES AND QUANTITY OF DRAINAGE WATER

The method of estimating the amount of drainage water was described as follows: In a project of this kind the drainage water is made up of runoff from rainfall, and seepage either through the levees or through other underground channels. Although there are certain features, such as rate of rainfall, duration of rain, state of land cultivation, etc., which are not subject to precise determination, still the quantity of drainage water occurring at the pumping plant can be determined with sufficient accuracy to provide for maximum pump capacity. On the other hand, an accurate estimated flow of seepage may not be as readily determined; but this flow is unnecessary in the design of pump

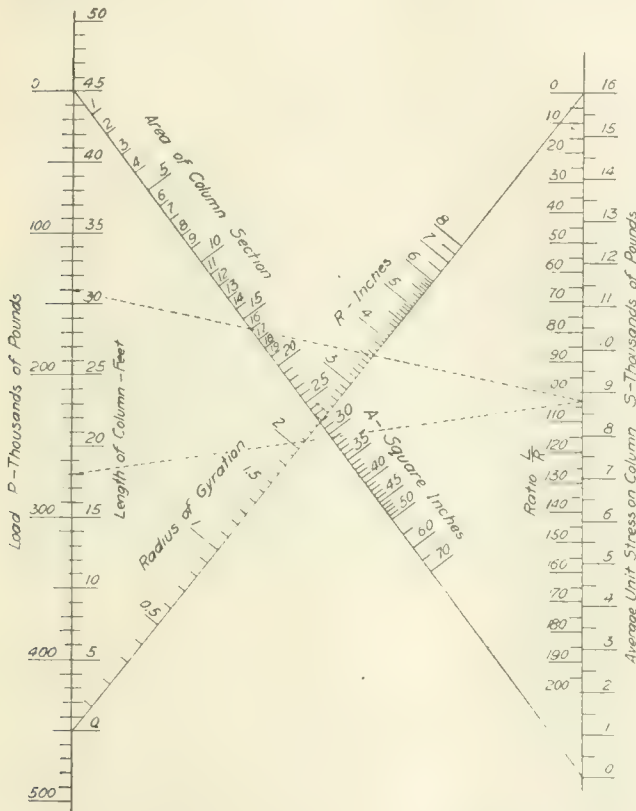


CHART SIMPLIFIES SOLUTION OF A. R. E. A. COLUMN FORMULA

tions for columns required to carry a given load, or to find the safe load of a given column, according to the well-known straight-line formula $S = 16,000 - 70L/R$. The chart is particularly useful in cases where numerous column sizes are required, the load and length of each being known.

DIRECTIONS FOR USE—APPLICATION TO PROBLEM

Given the load, length and any assumed radius of gyration, the slenderness ratio L/R , the average allowable unit stress S , and the required area A can be determined by two moves of a triangle or other straight edge. An example will indicate the procedure, as illustrated by the dotted lines on the diagram.

For a column to carry 140,000 lb., 18 ft. long, least radius of gyration 2.1, place a straight edge at 18 on the inner side of the left vertical scale and at 2.1 on the inclined scale for R . The slenderness ratio is then read as 103 on the inside of the right vertical scale, the straight edge is swung around this point to an intersection with 140,000 on the outside of the left vertical

capacity, as the quantity of seepage at any time, estimated at $\frac{1}{2}$ to $1\frac{1}{2}$ sec.-ft. per mile of levee, is slight as compared with the maximum drainage from rainfall.

Previous to the investigation there had been no observation of rainfall within the district. However, there were nearby recording stations, from the readings of which an analysis of the estimated rainfall was made and the maximum period of rainfall determined.

HOURLY RUNOFF

The hourly runoff, due to hourly rainfall, Mr. Noble points out, is that which determines the required capacity of the pumps in a problem of this nature. It varies with many conditions, among which are the rate and duration of rain. It is not as readily approximated as the yearly runoff, which may be determined very accurately from the yearly rainfall, and therefore it becomes necessary to assign to the maximum recorded rainfall a given hourly rate. Grunsky's method of estimating the hourly rate of rainfall was accordingly adopted with some modification. This method assumes that 50 per cent more rain falls in any one period than in the preceding period. It was further assumed that the rainfall rate for any one day was a minimum at the beginning, increasing at the above 1 to $1\frac{1}{2}$ ratio to a maximum which lasted for three hours during the middle of the day and then decreased to a minimum at the end of 24 hours in a $1\frac{1}{2}$ to 1 ratio. An average rainfall rate of $1\frac{1}{2}$ in. per day was adopted.

RUNOFF ESTIMATED AT 25 PER CENT

It was estimated that 25 per cent of the rainfall would arrive at the pumping plant in the form of runoff, this varying with the rate of rainfall, being greatest with the greatest rate. With equal rates and at intervals equidistant from the peak, it was assumed greater during the latter part of the day than earlier.

Previously in the district there had been laid out a system of drainage ditches, so designed as to carry the water at a certain velocity. It was therefore assured that the ditches were equally effective as far as the delivery of water to the pumping plant was concerned. The reclamation district was accordingly divided into various runoff zones, so selected that from each successive unit water would require one more hour to reach the plant. The time required for the rainfall to reach the ditches was assumed the same for each zone and was therefore omitted in the calculations.

DESIGN OF PUMPING PLANT

In designing the pumps, the suction was extended to a point 10 ft. above datum. It was assumed that without serious flooding water could rise to a point 20 ft. above datum, which would give a storage capacity of approximately 1150 acre-feet and necessitate a pump capacity of 1000 to 1100 sec.-ft.

The pumping head was designed to meet maximum conditions. Generally the peak of flood waters occurred from one to three days after the rainfall, but since conditions might cause the peak to arrive simultaneously with the maximum runoff discharge it was decided to provide pump capacity correspondingly large in order to meet this possible maximum head. Prior to the construction of the levee, a maximum flood height of 39.2

ft. above datum had been recorded. After investigating conditions governing the maximum head, which would occur after the levee had been constructed and the water excluded from the overflow district, it was decided to make the discharge water level 42 ft. above datum. This investigation was also necessary for determining a safe height for the levee.

An elevation of the water surface in the suction sump was taken as 16 ft., thus giving a maximum static head of 26 ft. With an estimated friction loss in the discharge pipes of 3 ft., a total maximum pumping head of 29 ft. was obtained. Pumps were therefore selected to handle 1000 sec.-ft. against a 29-ft. head.

Electric-motor-driven centrifugal pumps were chosen, the selection being influenced by the fact that there were three power companies within a reasonable distance. It was also thought that the advantage of lower initial cost greatly offsets a slightly higher operating expense. The pumps were designed for six units, each being 50 in. and having a normal capacity 175 sec.-ft. against a discharge head of 29 ft. Each unit is to be driven by an 800-hp. electric one-speed motor.

PLANT OF MINIMUM CAPACITY

A plant of minimum capacity was designed on account of the construction problems. Each pumping unit is independent of the remainder and has a separate steel suction pipe. The discharge pipes from each of two units is brought into a single reinforced-concrete pipe, 78 in. in diameter, which in turn passes through the levee into a valve chamber. Here are inserted a large wood and steel swinging check valve and a sluice gate. No valves appear on the suction, but on each discharge there is located, just outside the building, a 50-in. gate valve. These valves are operated by a direct-current motor located within the building and connected by a shaft passing through a stuffing box in the wall. A switchboard placed at one end of the building operates all valves and motors.

Priming pumps of the wet vacuum type, capable of priming one pump in 10 minutes, were installed in duplicate. For operating the gate valve motors, a storage battery was designed, so as to replace the main source of supply in case of failure. Electric power is delivered to the motors at 2220 volts from three 1500-kva. outdoor-type, oil cooled transformers (60,000-22,000-volts) mounted on a platform.

The total cost of the plant, exclusive of engineering, was approximately \$170,000, of which the building, discharge pipes and sump represent \$75,000, and the pumping machinery \$95,000. It was estimated that power consumption for the pumping runoff only would be 700,000 to 1,200,000 kw.-hr.

TESTS

The electrical input to the motor was measured by means of two indicating wattmeters. The discharge head on the pump was obtained by means of a U-tube of water, the total pumping head being taken as the difference in the level between the water in the sump and height of water shown in the U-tube. The amount of water was obtained by means of a Cole and Flad pitometer. Only a preliminary test on one unit had been made at the time of presentation of the article, so that accurate results could not be given.

Chicago Has Problem to Protect Street Traffic at Drawbridges

New Devices, Installed to Prevent Pedestrians and Automobiles from Plunging Into River, Include Flashing Signals on Gates and Cushion Barriers

By F. H. AVERY

Engineer in Charge of Bridge Repairs, Chicago



FOUR RED LIGHTS PLACED ON EACH ARM FLASH ALTERNATELY, GIVING AN IMPRESSION OF A WAVING SIGNAL

RECENT DESIGNS in stop signals, barrier gates and derails for city drawbridges, some of which have already been installed at Chicago, have in view the protection not only of the pedestrian but of the automobile, motor truck and the electric railway car as well, even to the extent of coping with careless driving. The most recent installation, that of a barrier gate, is designed to stop a 4000-lb. machine traveling 30 miles per hour.

When a crossing policeman blows his whistle on a downtown corner, the public obeys instantly and stops, but when a bridge bell rings, the traffic makes a frantic attempt to cross the bridge before it opens. The engineer must recognize this fact and make his first effort along the line of teaching the public what to do when the bell rings. In all countries and times the ringing of a bell has been an alarm signal, and there is no doubt that the sudden ringing of a bell still raises a feeling of alarm and terror. This may easily account for the unnecessary and undesirable stampede of the traffic.

STANDARDIZATION OF STOP SIGNALS A HELP

The object of this article is to call public attention to the danger at bridges and also to decrease the danger by standardizing stop signs and educating the public to them. It is evident that gates are necessary and must have aprons so that people cannot crawl under

or around them when they are lowered; also that any system of stop signals must be preceded by a long and systematic campaign of education before the signals will do much good, as the public is not trained to observe signals.

SIMILARITY OF FIXED AND MOVABLE STRUCTURES CAUSE OF CONFUSION

One source of trouble is the fact that when a drawspan occurs near the center of a long viaduct with through trusses, a driver cannot tell at night or in rainy weather when he is approaching the draw, because of the similarity in the fixed and movable structures. Several cases have occurred where machines have climbed a bascule leaf after it has started up. It is evident, then, that the stop sign must be very compelling in its effect on the public and of such a nature that people not used to it or not knowing where to look for it will see it instantly when it is displayed.

If signals were standardized all over the country, the drivers would know a stop sign when they saw one. All automobile magazines and clubs should aid in this, and it must be impressed on the driver that "Stop" means cease moving.

In Chicago a hand bell is rung as a warning to the traffic to clear the span so that it can be opened. Then a jingler or vibrating electric bell is rung, two electric lighted stop signs are started on each approach

and finally the gates are lowered before the span is opened. This should cause the oncoming traffic to stop, so that the only time lost is that required for the traffic to pass over the span, generally about 1½ minutes.

EARLY STOP SIGNS

The first stop signs were composed of a sheet-metal box with red glass front reading "Stop" vertically and lighted by two rows of five lights each, that burned in series. Two rows of lights were used, so that if the carbon filament in a lamp broke, the signal would not fail. This signal took care of team traffic fairly well, but as it stood close to the curb, overhanging coal wagons broke it, or teams stopping in front of it completely hid it from view. As soon as the fast-moving auto came into general use, the signal was outgrown, for frequently the driver of an auto running around a team failed to see the box, while the noise of the engine drowned that of the jingler.

The next signal tried was the so-called wigwag, consisting of a red disk that swings back and forth and which has a red light at the center. The disk is marked "Bridge Danger," while on the post is a sign that reads "Danger," in red letters. At first the autos stopped, particularly at night, but as soon as the drivers became familiar with the new signal they sped ahead on seeing the wigwag begin to move. This is a good signal to guard a railroad crossing, but is nearly useless on a congested city span, because it stands too high. The signal did, however, show that no signal so far offered was satisfactory.

FLASHING SIGNAL PLACED ON GATES

The writer evolved the idea of placing the signal on the gate itself, where it could be seen at any distance or position, and where, best of all, the driver could not run by it without running over it. The actual working out of the details of the first signal of this type was done by Mr. Harrington of the City Bridge Division.

The present stop sign is substantially made of cast iron and placed so that it cannot be knocked down, and the new type shortly to be installed will have the shape of ornamental pylons, in accordance with the city-beautiful idea. Four red lights placed on each arm are so arranged by means of a flasher that one stop light burns "Stop" at the curb and then the signal runs across the gates and the opposite stop sign lights up, after which the procedure is reversed, thus giving the impression of a waving signal.

That putting the signal out on the arms has had a wonderful effect in decreasing gate breakages is shown by the fact that the arms on Lake Street Bridge, where the first signal of this type was installed, have not been broken since the installation, while in the same length of time the unlighted Rush Street arms have been broken so often that in some cases the gates have not been operated for a month at a time.

HIGH VISIBILITY OF NEW SIGNALS

At night the visibility of the new signal is vastly superior to anything that has been produced up to date, due to the fact that, extending as it does from curb to curb, it cannot be hidden by traffic. The lights begin to flash while the arms are in the up position, thus

still further increasing the visibility, for the driver sees the motion of the down-coming gate outlined for him by the flashing lights. Multiplying the number of signals that convey the same warning is wrong in principle, but certainly experience has proved that both a visible and an audible signal must be used, and also that the gates must be made so that they cannot be passed by anything larger than a dog.

NECESSARY FEATURES IN GATE DESIGN

The gate, to be any protection, must have an apron on it so that no one can crawl under it, and must extend from handrail to handrail so that no one can walk around it.

The first gates were air-operated and could not be reversed quickly once they were started down. This was one of the main troubles. The bridgetender's chance of preventing a broken gate was almost none, for he could not reverse the gate in time. The air gate could not be operated at all by the bridgetender in the case of a drawspan.

The electrically operated gate avoided these two serious faults. Instead of having trolley wires at the spider casting, contactors were placed at the ends of the center truss. These consisted of wheel contacts that wiped against copper strips placed on the abutment. This worked out very well, for after the bridgetender had lowered his gates and made his swing, he reversed his switches while waiting for the boat to pass, then as soon as the bridge was centered again on the abutments the gates all rose automatically from the action of the contactors.

PROTECTION OF GATE AGAINST WRECKING

The present gate arm is provided with a hinge and wooden pin at the curb line, so that when hit the pin shears off and allows the arm to swing around without breaking. The gate post is set back at the handrail of the sidewalk, thus avoiding the use of sidewalk arms, although of course it lengthens the street arms. If the post cannot be set back in this manner, a heavy pipe is set in concrete in such a way as to protect the gate by wrecking anything that runs into the pipe.

The swing and vertical-lift bridges need the gates more than the bascule type, since the latter block the roadway once they are up. This distinction at once brings out the question, If the gates are placed at a swingspan, why not have them of such a nature as really to stop traffic? In many of the drawbridge accidents a very small resistance would catch a machine and stop it entirely. There are numerous devices of this kind patented but not in service.

THREE ESSENTIALS OF ELECTRIC GATE

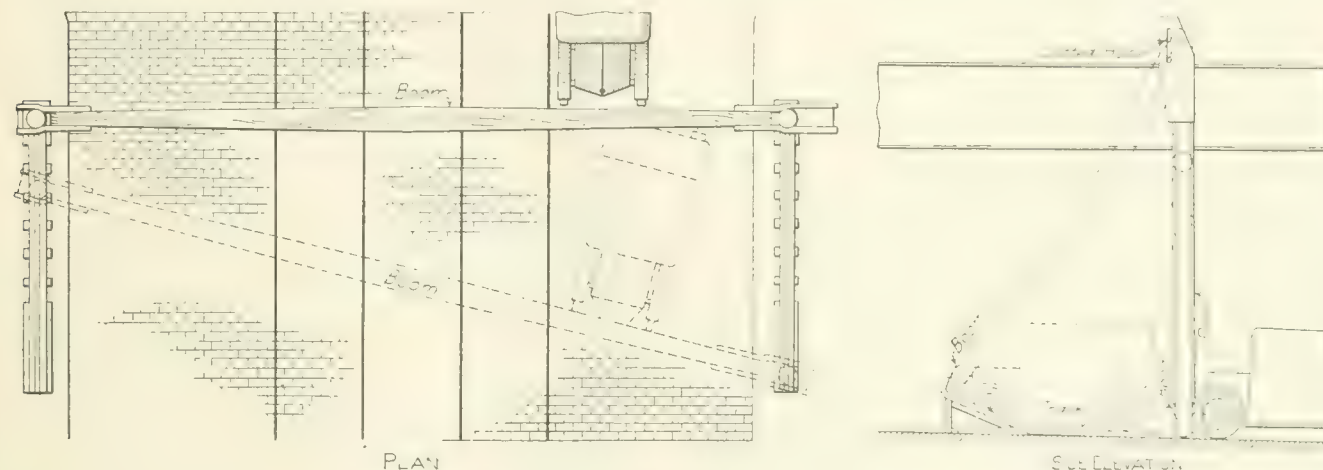
There are three essential points in a good electric gate: The machinery portion of the post must be accessible for repairs with the gate in the open position; the gate must absolutely lock both in the open position so that the wind cannot blow it partly down and also in the down position so that it cannot be thrown up, and it must have a hand-operating device by which it can be raised to the clear position in case of electric trouble. Furthermore, the parts must be free from eccentricity and lost motion, so that the arms cannot lash back and forth, and there should be no landing

rod to stop the gate in the closed position, as this breaks the filaments of the signal lights. The gate mechanism must be simply and ruggedly made and the electric switch or cut-out free from arcing trouble.

CUSHION-BARRIER GATE, LATEST DESIGN

The writer has designed and is installing at the Lake Street Bridge a cushion-barrier gate. It consists of a boom which travels vertically on two posts at the curb line, the posts being free to swing at the top and slide at the bottom. When the boom is struck by a machine, the post rolls backward about a foot on a wheel placed at the bottom of the post. The motion then changes from rolling to sliding by means of a track which picks the post up on two bearings outside of the wheel. The post slides horizontally for 10 ft. and then climbs at an angle of about 45 deg. for 5 ft. more. To provide for the lengthening of the post which this motion requires, the support at the top on which the post turns has a slotted hole.

The boom is of Douglas fir, 16 in. in diameter, and



STOPS A 4000-POUND MACHINE RUNNING 30 MILES PER HOUR WITHOUT INJURY TO PASSENGERS

has forked ends, so that when struck by a machine close to the curb the post on that side can start independent of the opposite one, and the lengthening of the boom, which this requires, is given by the forked end, made of 3 x 4 x 1/2-in. angles.

The arm weighs 1000 lb., and the two posts with counterweights 3000 lb., making a total of 4000 lb. which must be put in motion when struck by a machine. The boom can spring 18 in. without breaking, and the tires furnish additional cushion, so that the rolling motion should take place without damage. The resistance then increases, with the change to sliding friction, and the stopping action is still further increased when it becomes necessary to lift the boom and posts a distance of 2 ft. vertically in the last 5 ft. of travel. There would still be left the 18-in. deflection in the boom. The gate is designed to stop a 4000-lb. machine going 30 miles per hour, without injury to its occupants.

MOVABLE SWITCH FOR PASSING TROLLEY WIRES

The trolley wires must be passed, and this is accomplished by a switch that is operated by the motion of the boom. The movable portion of the switch is not dead at any time, and so a car cannot get stalled in case it stops with the trolley on the switch.

The boom is fastened to the counterweights at each end by two cables, so that the breaking of one would not drop the boom on the traffic below. The cushion gate is just back of the electric gates, which are lowered first, after which the barrier comes down. The boom is so heavy that a machine cannot throw it high enough to hit the wind shield. It is also designed to withstand a street car. However, a heavily loaded truck would tax it severely.

This gate will be tested as soon as it is installed by running into it with an auto truck. It is hoped that the device will prove successful. It has no springs, cylinders or brake wheels to get out of adjustment.

The gate must be free from clogging by ice, sleet or street dirt. To cope with motor trouble it must be so constructed that the bridgetender can raise it by hand if the motor gives out, or so that if damaged by a machine he can clear the street for traffic.

A gate of this nature could be designed of sufficient strength to stop even an elevated train in case the automatic trip should fail to set the brakes. The com-

paratively light automobile should be stopped without trouble unless the speed is excessive.

A rigid gate has been installed at the Halsted lift bridge which follows the bridge up and displays a stop sign in red electric lights. It is much better than no gate, and if the driver all but stopped this gate would complete the stop for him. A rigid gate would be much cheaper than a cushion-barrier gate, but the gate should prevent loss of life or injury if possible, and not instantly stop a machine going 25 miles an hour.

DERAILS PREVENT ACCIDENTS TO CARS

Street cars on a swing or vertical-lift span should be protected by a derail operated by the bridgetender and interlocked so that the span cannot be opened unless the derail is open. Where the approach has a steep up grade to the span there is not much need for a derail, for even if the brakes refused to work the speed of the car would be checked by the up grade so that there would be little chance of its leaping over the abutment. Where the approach is level or on a down grade to the span, however, a derail is necessary. The city now operates seven swingbridges, three of which are already protected on one approach by a derail, and derails are now to be installed at all swingspans.

The Clark Street derail is interlocked with the end

lock of the span so that the operator cannot pull out the end lock until the solenoid located in the operator's house raises the dog on the push rod of the end lock. This solenoid is energized by the electrical switch, located at the curb opposite the derail, when the derail is open. This makes sure that the bridge end lock is released only when the derail actually opens, as otherwise the operator, not being able to see the derail or its target, might throw the derail lever and, because of a broken rod, proceed to open the span with the derail untouched.

The dog on the center lock is under a glass cover, allowing the operator to break the glass and raise the dog by hand in an emergency. He must then report the derail out of order. Such emergency repairs are made at any time during the day or night.

TROUBLE AT ABUTMENT

The most troublesome point in the pipe line of such a derail is at the abutment. It is hoped to overcome some of the difficulties by using at this point a spring which maintains a constant pressure of about 300 lb. against the casting on the end of the push rod at the end floorbeam of the span. This will take care of expansion and does not require the unlatching or unhooking of the pipe line at the abutment when a swing is made. If the operator closes the derail while his span is open, it means breaking off the castings at the abutment spring box. This is prevented by the bar between the end lock and derail levers in the operator's house, which is cross-connected to the derail lever, so that when the end lock is pulled after pulling the derail the derail cannot be pushed back again until the end lock is pushed back.

One bad feature about using the end lock to furnish the interlock is the bridgetender's habit of stopping the span with the end lock by leaving it in the locked position when shutting his span. Where the end lock is a straight in-and-out motion parallel to the center line of bridge the operator cannot stop his span by means of the lock.

A signal should be so wired that it interlocks with the controller to the bridge motors. Every span in Chicago is so wired that the bridgetender has to push in his jingler and stop-sign switch before he can get current to his controller to operate the main motors. However, if the signal fails to work, the operator can still get current, for if this were not the case the bridge might be struck by a vessel and destroyed, or if it occurred while the span were open it might delay emergency traffic.

CHANNEL LIGHT ADOPTED BY CHICAGO

Although channel lights do not affect street traffic, they are certainly stop signs for street traffic, and it may not be amiss to explain the type of light adopted at Chicago. After experimenting with mercury contacts, and pendulum types swinging back of colored glass, the writer designed the present double light hung on a pipe and changed from red to green by a switch located in the head at the top of the light. This switch has no springs and is operated solely by gravity. As the span rises, the light hanging vertically pushes the jaw of the switch around by means of a cam fastened to the bridge.

This light has proved a great success and has never given a false signal. The lamps can be rotated on the pipe in case a bridge crosses the channel at an angle. The lamp has a hand line attached to the bottom and to the bridge handrail, and can be swung up 180 deg. and cleaned. In the same manner the abutment lights, wherever possible, are hung on long pipes turning in a socket.

Ample arrangements must be made for oiling a pendulum light to prevent rusting. These lights are oiled from a pipe reaching up above the top cover of the casting covering the switch mechanism. The bulb of the electric light must be provided with a good spring socket, as no filament made will withstand the constant jarring of traffic. Each set of two swinging lights and each set of two pier lights has a telltale light burning in a box in the bridgetender's house, so that he can always tell at a glance whether his lights are burning.

The guards at a bridge should not be policemen, but they should be in uniform and wear a shield. Such guards would be under the same authority as the bridgetenders and work more in accord with them.

Chicago now provides a house for the bridgetenders, with furnace heat, toilet, washbasin and towel service

COST OF EQUIPPING A BRIDGE

Gates and Stop Signs

4 gate posts at \$200.....	\$800
4 stop signs at \$70.....	280
4 gate controllers at \$35.....	140
2 flashers at \$75.....	150
2 vibrating bells at \$20.....	40
8 light sockets at \$2.50.....	20
Total material.....	\$1,430
Installation, 75 days, at \$6.....	450
	\$1,880

Emergency Lights

2 emergency lights at \$5.....	\$10
2 resistance plates at \$10.....	20
Total material.....	\$30
Installation, 10 days at \$6.....	60
	\$90

Channel Lights

4 swinging lights at \$37.50.....	\$150
1 pier lights at \$7.50.....	30
Total material.....	\$180
Installation, 25 days, at \$6.....	150
	\$330
Or a total of.....	\$2,300

and telephone. They work in eight-hour shifts. The changed conditions have more than paid expenses. A better class of men has been attracted to the service, which has resulted in reducing damages due to operation.

The bridgetender is required to inspect his bridge when coming on watch and make a test swing once a day in winter to be sure he can open his span for an unexpected trip of the fireboat. He must clean and inspect all his signals, including the channel lights on the span and abutments.

A complete set of signals for one trunnion-type bridge can be installed for about the figures shown in the accompanying table. When the total shown there is multiplied by 46, it gives more than \$100,000 to equip Chicago's bridges with modern signals, and this is now being done as rapidly as funds will permit.

This work is being installed under the direction of Thomas G. Pihlfeldt, city bridge engineer, and John Ericson, city engineer.

Fluctuations in Prices Make Changes in Design Desirable

Disproportionate Rise of Steel Argues for More Concrete—Wood Often Desirable—Prices of Capital and Labor Pertinent

By P. R. ELFSTROM

Assistant Engineer, Chicago, Milwaukee & St. Paul Railway, Chicago

ENGINEERS who are not actively engaged in the design and estimating of engineering structures are at present somewhat bewildered by some of the seeming departures from economical and standard practice which are being made by designers during these days of skylarking prices. They have developed by experience a sense of proportion for structures which needs revision in many cases. This is not due to the simple advance in prices but to the disproportionate advance in the different classes of materials. For example, the five main items which an engineer has to deal with have increased about as follows in the three-year period ended Jan. 1, 1917: Steel, 100 to 120 per cent; concrete, 30 to 40 per cent; wood, 20 to 30 per cent; labor, 25 to 40 per cent, and capital, 35 to 45 per cent.

MORE CONCRETE, LESS STEEL

The first thing which the foregoing comparison indicates is the necessity of revising the proportion of steel, concrete and wood required for any one structure. The economical design of 1917 allows a considerable increase in the quantity of concrete in order to reduce the amount of steel which, in 1914, would have proved economical. As an illustration of this the following case is assumed: A railroad bridge is to be constructed across a narrow creek channel about 150 ft. wide and 70 ft. from rail to ground at the center of the ravine. In 1914 a large per cent of engineers acquainted with bridges would have recommended that for permanent work a 150-ft. through truss on concrete abutments would be the most economical design. This very probably would have proved to be the case.

At the present prices, however, the illustration shows that it would be more economical to construct three 50-ft. deck-girder spans on heavy piers. This scheme reduces the amount of steel by 174,000 lb., or about 60 per cent, and increases the concrete masonry by 800 cu. yd., or about 120 per cent. This per cent of change in the proportion of steel to concrete is probably much more than would appear in most designs, but it illustrates the importance of the question.

DUPLICATION DISCONTINUED

Another item in connection with the design of steel work at present is the discontinuance of duplication to a certain degree. Cases are numerous where, in 1914, it would have been economical to duplicate, as the extra steel paid for would have been cheaper than the drafting-room and shop expense. At present, extra drawing and shopwork are being done to save steel on account of the excessive cost of the extra material.

The item of repairing and strengthening old steelwork is now much more important than in 1914. Steelwork which in 1914 was considered to have outlived its usefulness can now be repaired and strengthened with

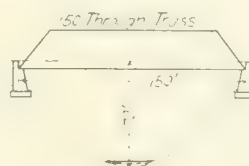
great economy, and fortunate indeed is the corporation or individual with a large second-hand stock of steel on hand. Reconstruction costing more than the original steelwork will often be found economical.

POSSIBLE SAVINGS IN CONCRETE

While the increase in cost of concrete has not kept pace with that of steel, it has made a considerable advance. The difference is large enough to permit the substitution of a reinforced-concrete design for the steel design in a great many structures where the two are in competition.

The increase in cost of concrete is due largely to the advance in materials, and these have also advanced unequally. Reinforcing bars and cement head the list, and any change in design which will save money on these

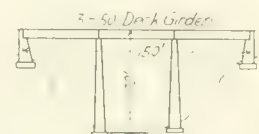
COMPARISON OF COST AS OF 1914 AND 1917 RESPECTIVELY OF TWO TYPES OF STEEL BRIDGES



150-FOOT THROUGH TRUSS

1914	
Steel 3 cents per lb.	
Concrete \$9 per cu. yd.	
Steel, 294,000 lb.....	\$8,820
Concrete, 650 cu. yd....	5,850
Total	\$14,670
Annual charges	\$1,040

1917	
Steel 6 cents per lb.	
Concrete \$12 per cu. yd.	
Steel, 294,000 lb.....	\$17,640
Concrete, 650 cu. yd....	7,800
Total	\$25,440
Annual charges	\$2,134



THREE 50-FOOT DECK GIRDERS

1914	
Steel 3 cents per lb.	
Concrete \$9 per cu. yd.	
Steel, 120,000 lb.....	\$3,600
Concrete, 1450 cu. yd....	13,050
Total	\$16,650
Annual charges	\$1,080

1917	
Steel 6 cents per lb.	
Concrete \$12 per cu. yd.	
Steel, 120,000 lb.....	\$7,200
Concrete, 1450 cu. yd....	17,400
Total	\$24,600
Annual charges	\$1,866

two items without undue increase in the remainder will be found economical.

Steel and cement can both be saved by the adoption of more of a mass design for certain structures, the use of a leaner mixture and the elimination of reinforcement to a certain extent. Take, for example, the case of concrete reinforced 1 per cent. This gives about 130 lb. of steel per cubic yard of concrete, which at 4 cents per pound equals \$5.20. Adding labor to bend and place this at \$2 per cubic yard makes a total of \$7.20 that can be saved per cubic yard in case reinforcement can be eliminated. If the mixture could then be made 1:3:6 instead of 1:2:4 about 90 cents would be saved in cement. Assuming that plain concrete can be poured for \$12 per cubic yard, it is easily seen that the yardage of a structure can be increased up to 65 per cent over and above the reinforced design and still be the more economical of the two. Large corporations working from standard plans adopted prior to 1914 can well afford to look into the matter of revising them for use under the present scale of prices.

Wood has made a less proportional advance in the last three years than either concrete or steel. Although the life of a wood structure is comparatively short, the low original cost will often make the annual charges or the sum of annual depreciation, annual maintenance

and annual interest on money invested less than the annual charges on a more permanent structure.

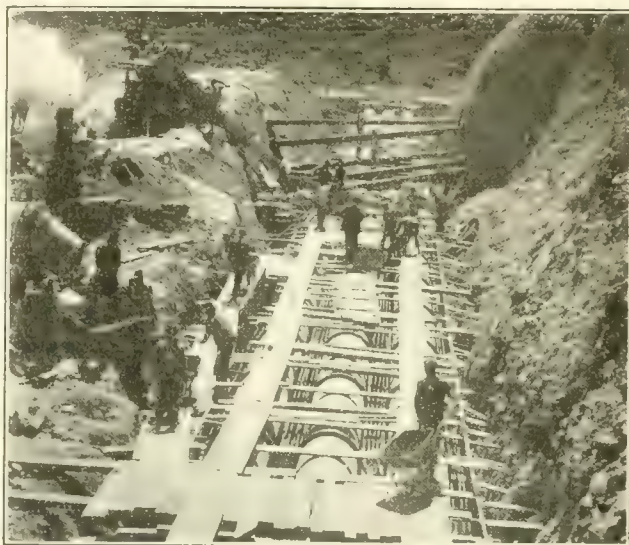
For example, the bridge used in the foregoing illustration could be assumed to replace a timber trestle. The annual charges to renew this in kind in 1914 would probably have been around \$1200, which would have proved any one of the permanent structures to be more economical. In 1917 these annual charges for a renewal in kind would amount to about \$1600, due to the increased cost of timber and capital. Even this, however, would be more economical than any of the permanent schemes outlined. The chances are that when this wooden structure would again need renewal, capital would be cheaper and war prices on material would not be in force.

There is also a chance that even where the annual charges on a wood structure would now be higher than those for a permanent structure, the sum of the annual charges to carry a wood structure 12 years and thereafter a permanent structure would amount to less in 50 years than to construct the permanent structure at present.

As stated in the wood-trestle illustration, the price of capital will sometimes change the type of structure entirely. One of the important elements of annual charges is the interest required to finance the construction. In the case of a permanent structure with low maintenance charges and long life but high original cost, the interest on the money invested is the main factor in the annual charges. Consequently when the price of capital is high, it pays to install structures with low original cost and await a more favorable period to construct a better structure.

The labor market is very peculiar in that, although the price of labor has not made such a large proportional advance as some of the other items, still the supply seems to be limited. If a structure required speedy construction, the labor item might be the main reason for choosing a type of structure on which the per cent of labor cost was low. In 1914, when labor was plentiful and cheap, it might have been economical to choose the type of structure with a high per cent of labor cost.

The foregoing statements indicate a few of the many things affecting the design of a structure which can be changed by fluctuations in the price of materials. It can readily be seen that standard practice of the past is not always the most economical at the present, and the engineer who is not up to date on prices of materials is not competent to judge the design of a structure.



PIPE LAID BEFORE PLACING CONCRETE CRADLE

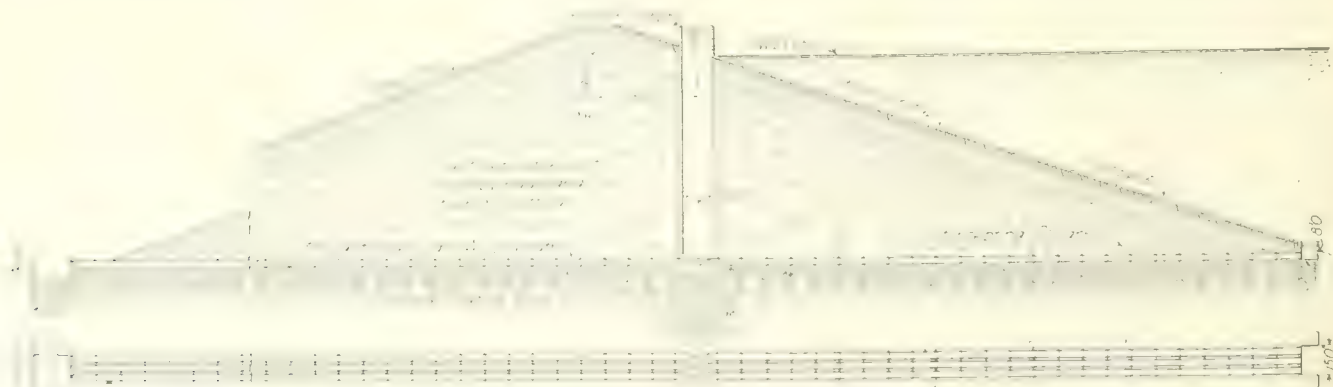
Build High Earth Dam by Alternate Ridge-and-Wet-Trench Method

Outlet Pipes, Laid on Concrete Slab, Pass River Discharge During Construction of Dam for Colorado Irrigation Reservoir

EMPLOYING the ridge-and-wet-trench method, an earth dam 120 ft. in height is being built on Costilla Creek, in northern New Mexico, near the Colorado line, about 60 miles southeast of Alamosa, Col. During the construction the creek will be diverted through the permanent outlet pipes, laid in advance during the past season. The dam, designed to create a reservoir for irrigation purposes, will impound about 15,000 acre-feet of water. It is being constructed for the Costilla Estates Development Company, to supplement the supply now furnished by the Sanchez reservoir, described in the Engineering Record of Feb. 4, 1911, page 130. The water will be diverted at an existing dam 20 miles downstream.

CONCRETE CORE WALL EXTENDS INTO UNDERLYING CLAY

The dam will have a slope of $2\frac{1}{2}$ to 1 on the downstream side and of 3 to 1 on the upstream side, which will be paved with 18-in. riprap. Its top, 20 ft. wide, will extend 600 ft. across the cañon. There is no solid rock at the site of the dam within reasonable limits of



VALVE GATES OF CAST-IRON OUTLET PIPES CONTROLLED FROM TOWER SET UPSTREAM FROM CREST

depth. As a precaution against percolation through the foundation material, which consists of a firm clay intermixed with gravel, a thin wall of concrete has been placed entirely across the site and up the sides of the valley to a level about 50 ft. above the natural surface at the bottom of the depression. This wall is carried to a depth of 30 ft. into the foundation material across the bottom of the site and to a distance of not less than 10 ft., normal to the slope, into the sides of the cañon. It extends at all points 5 ft. above the natural surface. The wall, 2 ft. thick, is reinforced throughout with $\frac{3}{4}$ -in. twisted steel rods, spaced 3 in. in from each face. Both horizontal and vertical reinforcing are used, the rods being spaced 2 ft. apart each way.

DAM TO HAVE PIPE SPILLWAY

A spillway is provided through the ridge of the basin at one end of the dam. It consists of an open cut and a concrete structure leading to a riveted steel pipe, which will discharge the water back into the stream below the dam. The pipe, which is of $\frac{3}{4}$ -in. steel plate, will be supported by concrete piers 25 ft. apart. It will be anchored to these piers by steel rods set in the concrete and bent around the pipe in the form of hoops.

The outlet pipes by means of which water will be drawn from the reservoir as desired extend entirely through the base of the embankment. Cast-iron pipe was adopted in preference to concrete, according to the engineers, because of the greater certainty that it could be made watertight under pressure. Above the gate tower the pipe will be subjected to a head corresponding to the height of water in the reservoir. These outlets consist of three lines of 36-in. cast-iron pipe placed in a heavy slab of reinforced concrete carried on supporting walls 12 ft. apart. The walls extend into the original ground 10 to 25 ft., depending on the class of material and the distance from the gate tower, the greater depths being near the gate tower. The piers were built first and the pipe laid on them, being supported just back of the bells. The joints were calked and the lines tested to a pressure of 100 lb. per square inch. The reinforced-concrete slab in which the lower half of the pipes is incased was poured around them after they were tested.

GATE TOWER PLACED UPSTREAM FROM CREST

The circular tower for operating the gates is located 50 ft. upstream from the center line of the embankment. The regulating gates in the base of this tower consist of two sets of three heavy 36-in. Rensselaer valves each. The upstream sets are for emergency use only and will be open except when the other set is under repair. The other set will be used as the regular service gates to draw off water from the reservoir. The valves are flanged, and the connection between the corresponding valves of each set consists of a flanged special of the same diameter as the outlet pipe. The gates are to be controlled by 3-in. steel stems extending to the top of the tower. They will be actuated by hand wheels, so geared that they can be operated by one man. The tower itself has an inside diameter of 15 ft., with walls 24 in. thick at the base, diminishing to 15 in. at the top. Its foundation extends to a depth of 33 ft. into the material underlying the site.

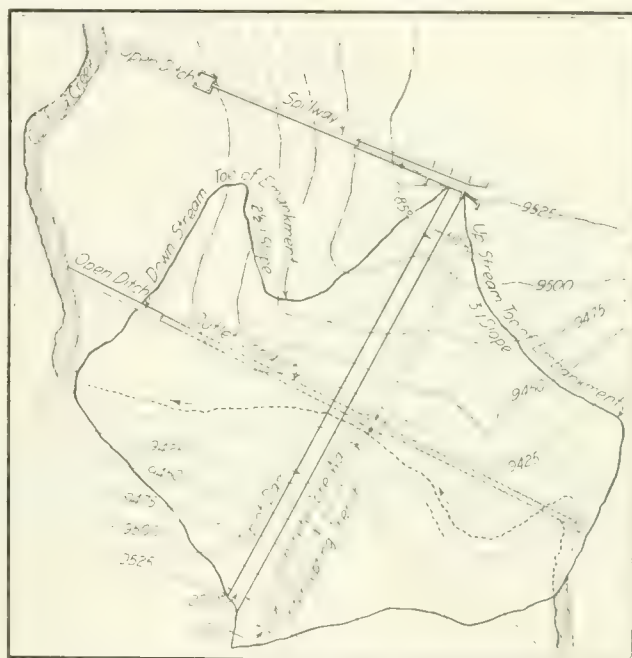
The intake end of the conduit is protected from debris

and driftwood by a steel cage of angles and channels. The total openings through this grating approximate two and one-half times the area of the outlet pipes. This cage is set in the top and front of the inlet structure.

OUTLET HAS WATER CUSHION

The outlet end of the conduit is a heavy concrete structure that effects at the same time a drop and a water cushion, or pool, for breaking the force of the issuing water.

If the reservoir were full and all gates open, the velocity of discharge through the outlet pipes would be about 40 ft. per second. This condition, however, is practically impossible, as the surplus run-off from flood discharges will be cared for by the spillway. In ordi-



CORE WALL OF COSTILLA CREEK DAM IS UPSTREAM FROM CENTER LINE

nary service the outlet tubes will never be required to pass more than 300 ft. per second, involving a velocity of about 10 ft. per second.

FILL DEPOSITED IN ALTERNATE DRY RIDGES AND WET TRENCHES

The material used for the construction of the earth embankment is to be transported from borrow pits located about 4000 ft. from the site of the dam. It consists of a firm clay mixed with gravel. The material will be loaded by a steam shovel into 3-yd. cars, hauled to the dam site over a railroad constructed for the purpose and dumped into loading chutes, from which wagons will distribute it upon the embankment. The equipment used is the same that was employed in building the Sanchez dam, and the work is in the hands of the same contractor, M. A. Wogam, of Denver.

The material will be deposited in low ridges about 5 ft. in height separated by trenches. The trenches will be partly filled with water and then filled to the level of the adjoining ridges by earth dumped from the ridges. New ridges will then be constructed vertically over the position of the trenches, with trenches between them

vertically over the preceding ridges. The embankment will be completed with a succession of these operations, the top of each preceding ridge becoming the bottom of the succeeding wet trench, and conversely, throughout the entire process of depositing fill.

MATERIAL HAULED LONG DISTANCE TO SITE

All the material, including the 164 pieces of 36-in. cast-iron pipe, had to be hauled by team over a mountain road from Jaroso, the terminus of the 32-mile line of the San Luis Valley Southern Railroad Company, which connects with the Denver & Rio Grande Railroad at Blanca, Col. The branch road is the property of the Costilla Estates Development Company.

The designs for the dam were prepared by J. C. Ul-



MATERIAL FOR FILL DELIVERED ON TRESTLE AND DUMPED DOWN CHUTES TO WAGONS FOR DISTRIBUTION ON DAM

rich, of Denver, under whose supervision the construction is being carried out. The assistant, or resident engineer, in direct charge of the construction, is Neil C. Vandemoer, of Denver. The cost of the dam will be about \$350,000, and it is planned to complete the structure during the fall of 1917.

A Unique Road Model

The Pennsylvania Highway Department has had an unusual model made to show just how the relocation of old roads betters traveling conditions. This model measures 6 x 5 ft. and was made by a specialist in such work at Washington. It is in relief, with roads, fields, houses, trees and other features of the landscape reproduced to a correct scale. On it are shown three types of poorly located roads frequently found and the proper methods of relocating each so as to provide satisfactory grades and connect the terminal points in the most direct manner. The model also shows three types of road construction—waterbound macadam, bituminous concrete and cement concrete—with bridges and culverts of standard types. The model is being shown at county fairs and has attracted unusual attention, so it may be considered a decidedly successful educational exhibit which other state highway departments may find it desirable to duplicate.

Intake Gate Designed to "Skim" Colorado River Water

Imperial Irrigation District Announces Plans for Headworks of New Type to Collect Water Without Silt

A REINFORCED-CONCRETE headgate intended to skim off only the upper strata of water where the least sediment is carried has been designed for the Imperial Valley irrigation system. The improvement will be known as the Rockwood intake gate and is an item on the construction program recently recommended by C. E. Grunsky and George B. Anderson, consulting engineers for the Imperial Irrigation District, for immediate attention. The new intake, about 6000 ft. upstream from Hanlon Heading, will be supported on river silt of unknown depth; accordingly, it was designed broad enough to distribute weight over a large area. It was desirable to reduce the velocity of the inflowing water and to draw from a minimum depth. Taking these two points into consideration, the structure was made 60 ft. wide and 645 ft. long.

The superstructure will be founded on a concrete floor with Wakefield sheet piling cutoff walls driven 30 ft. below the sill, level along both up and down stream edges of the floor. A series of piers 8 ft. apart, parallel to the

direction of flow, will be supported on the floor and will carry three pairs of vertical grooves for three separate tiers of stoplogs, by means of which the flow into the canal will be controlled. The piers also carry a reinforced-concrete trough running the entire length of the structure, which is to be filled with earth and rock to give additional stability. A railroad track will be laid on top of the fill in the trough.

The opening between piers will be 6½ ft. in the clear. Twenty-seven of them will have gate sills at an elevation of 96 ft.; the sills in the remaining 48 openings will be placed at elevation of 104 ft., this arrangement being planned to provide sufficient capacity at extreme low-water flow without the expense of building a structure which could draw from these low levels along its entire length. At the point where the transition is made from one sill level to the other there will be a concrete box 25 x 60 ft. in plan, extending the full height of the piers, which is to be filled with earth and rock to increase the weight of the structure at this point.

TO PROTECT BANK WITH REVETMENT

It is planned to protect the bank adjacent to the structure above and below the concrete work with rock revetment. As the shore line is to be moved back a considerable distance it will be possible to place this revetment in the dry by excavating a trench along the de-

sired location, filling in the rock and afterward dredging the foreshore remaining between the rockfill and the edge of the stream. The revetment work will extend 200 ft. from the structure each way, and is to be placed in trenches 10 ft. below sill level and 6 ft. wide on the bottom. Immediately in front and along the entire length of the intake proper a rockfill 25 ft. wide and 6 ft. deep is to be placed in the channel, with its top below sill level.

The work is expected to cost about \$200,000. Specifications require its completion by May 1, 1917. The contract was to have been awarded on Jan. 12.

Auxiliary Pipe Lines Necessitated by Failure of Dam

Second-Hand Woodstave Pipe Found Economical in Solving San Diego's Problem—A Diverting Dam Also Built

By A. C. FRANCIS
Operating Department, San Diego, Cal.

SAN DIEGO, CAL., has just completed the construction of pipe-line connecting links in the water-impounding system of that city made necessary by the failure of the Lower Otay dam, reported in the Engi-



BUTTRESSES PROTECT DOWNSTREAM FACE OF DIVERTING DAM

neering Record of Feb. 12, 1916, page 225. The first step taken toward rehabilitating the water system was to connect an auxiliary basin of 1,090,000,000 gal. capacity with the Otay-San Diego pipe line leading to the city by means of a 36 and 24-in. woodstave pipe line, 15,000 ft. long. About 1500 ft. of the 24-in. continuous wood stave was second-hand pipe which had been replaced by cast iron in a city street, and it is worthy of note that a saving of \$1,500 was made by using this old material. The total cost of the connecting line was \$41,369.

In order to divert the water carried from the Morena reservoir higher up on the system through the Dulzura conduit, and the Dulzura Creek from its old course over the Lower Otay to the Upper Otay and the mains leading to the city, a 36-in. woodstave line designed to carry 20,000,000 gal. daily was built from the Upper Otay reservoir to a diversion point on the Dulzura Creek, a distance of 23,700 ft. At Harvey, a diverting dam 400 ft. long, built of reinforced concrete, takes the flow from the creek and turns it into this line.

The woodstave pipe lines were laid by the Pacific Pipe & Tank Company, the city of San Diego doing all excavating and trestle construction.

Few New Buildings in Porto Rico Because of High Cost

Repair Work Is Biggest Item—New Construction Held Down by Increase in Price of Building Materials

ALTHOUGH building activities in Porto Rico for the year ended June 30, 1916, increased over the preceding year, the work is found to have consisted almost entirely of repairs and additions rather than of construction of new buildings. This was caused by the advances in the cost of building materials, especially in the price of lumber. An increasingly large proportion of the new buildings are constructed of concrete, according to the report of the director of sanitation of Porto Rico, from which these notes are taken. In Spanish times the better class of buildings were made of what is known as *mamposteria*, which consists of broken bricks and stones laid in a weak lime mortar. In some cases the mortar was made of clay and very little lime. This was generally faced with soft burned bricks, to protect which the outside was plastered. In many instances the walls were so poorly constructed that rats readily made holes through them, and there were frequently large hollow places in the walls which afforded excellent harboring places for these rodents. Cases are known where rats have gnawed holes through the soft bricks.

CONCRETE BUILDINGS USED MORE

Such construction is no longer permitted. It is not economical, because the old walls had to be made very thick. The much thinner and more solid concrete walls are now less costly. A number of years ago many buildings were constructed of concrete blocks, but they were found to be less satisfactory and more expensive than solid concrete walls reinforced with steel rods. A great many of the Porto Rico workmen have become expert in the decoration of concrete work, and unfortunately some of the newer buildings exhibit a regular riot of architectural adornment, continues the report. This phase of building must necessarily be only a passing fancy, for it is believed that the many examples of old

SUMMARY OF PORTO RICO BUILDING ACTIVITIES

Year ended June 30	New buildings	Repairs and alterations	Total
1913	1470	333	1803
1914	837	531	1368
1915	722	443	1165
1916	723	479	1202

Spanish buildings of dignified and solid construction will surely exert a restraining influence.

The many and disastrous fires on the island during recent years have also discouraged the construction of wooden buildings. The sanitary regulations require the use of concrete in many cases for the purpose of rat-proofing and cleanliness. These changes in construction have materially improved the sanitary condition of buildings throughout the island.

What Does "Permanent" Really Mean?

The Illinois State Aid Law has been so amended that it recognizes the existence of "permanent earth roads."

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

A New Era in Teaching English to Engineers

SIR: I have carefully read the article on page 291 of the issue of Feb. 24 of the Engineering Record and wish to state that the University of Cincinnati and the Massachusetts Institute of Technology are not the only schools where engineering students are taught engineering English.

First of all, the English courses at New York University are given with a big distinction in instruction between the arts students and the engineering students.

Then, again, the instructors in charge of the engineering students have been teaching this course at this university for the last five years and have been using no textbooks but periodicals, including the Engineering Record, for the last four and one-half years.

Does not this show that M. I. T. and the University of Cincinnati are not the only schools where engineering students are taught engineering English?

Brooklyn.

DICK A. DUPLER.

SIR: In reading the Engineering Record of Feb. 24 it seemed to me that your editorial dealing with "A New Era in Teaching English to Engineers" was not absolutely correct, since it left out New York University, which has been teaching English to its engineering students in a similar or better way for the last eight years.

Not only is technical writing taught, but the Engineering Record has been used in the course for more than four years, in lieu of a better textbook. You can see from the 1917 bulletin of the School of Applied Science that the course in English, as given to the undergraduate engineer, is along the lines of writing for which he will have the most need after graduation.

HENRY W. PARKHURST,

New York City.

Class 1919, N. Y. U.

[Mr. Parkhurst and Mr. Dupler have apparently read into our editorial a meaning which is not there. It must not be assumed that commendation of the work done at the Massachusetts Institute of Technology and the University of Cincinnati implies that English is taught well only at these two institutions.—EDITOR.]

Use of Contractor's Plant by Engineer Troops in the Field

SIR: I have noted with interest the articles by Lieut. C. E. Bregenzer, 22d New York Engineers, published in the Engineering Record of Jan. 13, page 46, and Jan. 20, page 101. The articles in general give an excellent idea of the work of engineer troops, and seem to call for remark as to but one particular. This is found in the issue of Jan. 20, page 104. Here the suggestion is made that engineer equipment of troops should include general contractor's plant, such as caterpillar tractors, pumps, air compressors, drills, road machinery, trench excavators, etc.

Lieutenant Bregenzer is correct in thinking that such equipment should be available when required, and the Engineer Department provides accordingly. Its proper place, however, is not in the combat equipment of troops but in the engineer columns behind the army, and in the engineer depots from which it can be sent forward as required and as conditions permit.

To make clear why such equipment has not been included in the field or combat equipment of engineer troops, it is necessary to consider the conditions under which engineer troops have to act on the work for which their normal equipment must be designed.

Engineer troops must be able to maintain their position in a marching column, composed of all arms of the service; they must not take up too much road space or interfere with the marching efficiency of the column. If they violate these conditions they will promptly be relegated to the rear, and instead of performing their proper functions will find that they might just as well have stayed at home. Pioneer troops, with a mobile force in the field, do not ordinarily have time to carry out such extensive work as to call for elaborate contractor's plant. They must be primarily equipped to do rough and ready bridge work, field fortifications, demolition work, etc., but must also be able, if operations slow up enough to permit it, to do more elaborate work with the heavy plant of the engineer columns and depots.

Until a few years ago the combat equipment of engineer troops contained a much larger amount of engineer tools and equipment than it does now. The amount of this equipment was so great as to interfere seriously with mobility, and after very thorough consideration a greatly reduced equipment was adopted, which meets the consensus of the best opinion in our service, and is closely similar to what is in use in the engineer services of the principal foreign armies.

W. M. BLACK,

Brigadier-General, Chief of Engineers, U. S. Army.
Washington, D. C.

Test of Low-Lift Drainage Plant

SIR: In the Oct. 7, 1916, issue of the Engineering Record, page 437, there was published a description of a low-lift drainage plant consisting of centrifugal pumps direct-connected to distillate engines. Since this article was written the final economy test has been run, and the results of this test show very clearly the small cost of fuel for draining lowlands in this territory when economical pumping machinery is installed. The head during the test ranged from 4.44 to 5.91 ft., the mean head being practically 5 ft., at which head most of the pumping will be done in actual service.

The fuel was a low-grade distillate costing about 5½ cents per gallon. During the test the fuel pipes were disconnected from the oil-supply tanks, and weighed oil poured into a bucket, from which it was drawn by the fuel pump.

The quantity of water pumped was determined by Pitot tubes in both suction pipes, with a tube in the discharge as a check. Simultaneous readings were taken at the three points. The head, or rather lift (as guarantees are based on difference in levels of suction and discharge canals), was obtained by simultaneous readings of gages in the suction basin and outfall canal.

The guarantee was exceeded by 15 per cent on an average of the eight sets of observations. The test was conducted by A. M. Shaw, engineer representing the purchaser, and by the writer, who was engineer for the contractor, A. M. Lockett & Company, Ltd.

The average runoff handled by a drainage plant in Louisiana is 24 in. per year, or 2 acre-feet per acre. The results show that 28,775 cu. ft. of water was removed per gallon of fuel, so that 2 acre-feet, or 87,120 cu. ft., would require practically 3 gal. of fuel, which at 5½ cents gives the fuel cost per acre per year at 16.5 cents.

This means that the fuel is the smallest item of maintaining and operating such an installation; interest on the investment in plant, canals, and levees (or in the care of a drainage district interest on the bonds) being the largest. On another similar small drainage district that has been under cultivation for several years the cost to the farmer for drainage, including interest, fuel and operation, has been about 75 cents per acre per year.

This indicates that it is a better proposition for the farmer to use drained rather than irrigated land, as the water tax on irrigated lands in the Rio Grande River Valley, for instance, is about \$10 per acre, and in the rice district of Louisiana and Texas about \$5.

New Orleans.

B. S. NELSON.

Compensation of Engineers

SIR: We have read a great deal recently of the decreased enrollment of engineering students, as well as the compensation of engineers, which in general have been theories and not facts. Let us examine an existing organization and see what we find.

Our example will be one of the largest employers of engineering talent in this country, whose maintenance of an engineering organization of several hundred members for special improvements and developments should be a criterion of the general conditions in this particular field. In passing, this corporation prides itself on its merit system, and distributes considerable literature to its employees and the public boasting of its organization, its taking care of its employees and its general esprit de corps, as well as having the reputation of maintaining a very efficient engineering force.

The following figures of the compensation of this engineering organization are approximately correct: Six per cent of the employees of this organization receive in excess of \$3,400 per year, 6 per cent between \$3,400 and \$3,000, 3 per cent between \$3,000 and \$1,800, 15 per cent between \$1,800 and \$1,400, and 70 per cent between \$1,400 and \$600, or an average yearly compensation of about \$1,600.

On account of lack of space we will not be able to analyze the workings of this entire organization, so will take the field force, which is typical. This force has direct charge of the planning and execution of the work in the field. We will, for comparison, divide this force into three classes—A, B and C.

Class A—Here we find those unfortunate men, the real unsuccessful type, on whom someone earlier in life would have conferred a great favor by discharging and having explained to them their utter unfitness for the work. They are the minority.

Class B—In this class are the easy-going men who just happen to be engineers of a kind, some with a little knowledge, but most of them through years of service have naturally absorbed enough to run an instrument, make a tracing, solve a plain triangulation, are good inspectors—in fact, are very essential in the makeup of a field force, as they are the majority and do just what they are told.

Class C—This is the valuable class, the members of which do things, have their employer at heart, and by work and observation are striving to better themselves in this their chosen field.

A salary adjustment in this organization within the past year is typical of the system which seems to place a premium on incompetence. To illustrate: Mr. B. of the indifferent class, who is entirely dependent on Mr. C. for instruction as to just what to do, having no initiative, received \$100 per month and by the adjustment received \$120 per month. Mr. C. received \$150 per month, but received no increase by this adjustment, as it set a salary limit of \$1,800 per year—that is, \$1,800 is the maximum salary limit for anyone receiving \$1,800 or less, according to this new ruling. By implication the capable men are asked to resign. It is implied that they are not needed, for surely a young man would be foolish to continue in this organization in view of this munificent zenith of \$1,800 per year.

The unfortunates are those of capacity who have given ten or fifteen years of the best part of their lives to a corporation which, when their experience, initiative and executive ability make them most valuable, says, "We will pay you no more, but we will increase the salaries of the less deserving."

What are the defects of this system? Indifference or ignorance of the duties and responsibilities of the lower salaried units of the organization by the authorities that set salary limits seems to be the chief defect. Why this indifference or ignorance? This condition is not the fault of the immediate department heads, among whom are some of the best executives and engineers to be found in the country. The salary limits are set by the powers higher up, who seem to think the remuneration of an engineer and a chauffeur should be the same.

The economics of this sort of salary adjustment seems to be personified in a hearsay quotation of a directing official when presented with a list of salary increases recommended by a department head: "What is the use of raising their salaries, they won't quit." Yet we are told one of the first rules of success is to show your ability to your superiors who can help you.

In this force your direct superiors are helpless, and the average man on an engineer corps has not as much chance to become acquainted with the general office staff as the general office elevator man, who at least sees them more frequently.

Of course, the outcome of such a system is ultimate failure, but this does not help those who by circumstances cannot start at the beginning again to build up prestige with some other concern. Yet, in view of this

condition, you will find captains of industry, bankers and prominent business men anxious to place their sons in this organization. There is something wrong with the publicity department, but—"What are you going to do about it?"

A SUBSCRIBER.

SIR: On reading the article on salaries of engineers in your issue of Jan. 13, the first thing which strikes me is the height of the average salary as shown.

I judge that these figures tell the truth as to the large proportion of the A. S. C. E. membership which has reported, and I judge from my eighteen years' experience that these figures do not fairly represent the many thousands of civil engineers, not members, from recent graduates to old men.

We all know that A. S. C. E. members are but a fraction, though truly the leading fraction, of all civil engineers. I consider that the figures given are cruelly misleading to the several thousands of young men who yearly enter and graduate from our engineering schools. I would like to see reliable figures on non-members of the A. S. C. E. from top to bottom.

In the U. S. Interstate Commerce Commission, in the particular division with which I am connected, a quick count shows that 820 men of all grades of civil engineers, of long and short experience, receive an average of \$1,201 per year plus an average of \$333.50 expense allowance per year—decidedly below the figures shown for even an experience of from one to five years.

My experience with railroad engineer departments would lead me to believe that the figures I cite would also apply approximately to the railroad civil engineers of the land.

Albuquerque, N. M.

W. H. BARNES.

Water the Chief Factor in Making Concrete

SIR: The writer has been very much interested in the discussion which has taken place in your columns since Nathan C. Johnson's article, entitled "Water the Chief Factor in Making Concrete," appeared in your Dec. 30 issue.

After all that has gone before in this important discussion I desire to call attention to the use of a small percentage of hydrated lime for the purpose of eliminating segregation, either wholly or in a great degree, from a practical viewpoint.

The desire for using excessive quantities of water in placing concrete is brought about more particularly by the desire on the part of the construction superintendent to "get the concrete into the forms." In order to maintain speed it is necessary that a concrete have two qualifications; that is, it must be sufficiently mobile to permit free movement through the chutes without segregation and it must be sufficiently plastic to be easily worked in the forms. If a mixture upon being placed would possess these two important qualifications, the desire for increasing the quantity of water would not arise. Therefore it seems that the question to be solved is one of finding a material that will introduce into the mixture these two qualities.

The following from a letter recently received from R. C. Hackley, engineer for R. C. Storrie & Company, the contractors who are erecting the Twin Peaks tunnel

in San Francisco, indicates just how effectively hydrated lime performs in placing concrete without segregation:

"The city engineer, M. M. O'Shaughnessy, wishing to have the tunnel as dry as possible, specified the use of hydrated lime in the concrete in the proportion of 8 lb. of lime to 100 lb. of cement. The concrete is mixed in the proportion of 1 part cement and 8 lb. hydrated lime, 2 $\frac{1}{4}$ parts well-graded sand and 5 parts crushed gravel graded from $\frac{1}{4}$ to 1 $\frac{1}{4}$ in. The mix gives a perfectly watertight concrete, although the ground passed through by the bore contains a large quantity of water.

"From the contractor's point of view the lime in the mix is a great advantage, as it holds the water in the mix, preventing separation and allowing a wet mix, which is necessary when placing through a long line of pipe, as is done on this work.

"On this work the pneumatic concrete placing system is used, and we have shot the concrete 2600 ft. through 8-in. pipe and expect to extend this line to 4000 ft. or more, the lime being a great help as a lubricant. Where chutes are used they can be much flatter and will carry the concrete much farther with lime in the mix; in fact, we have used lime for this purpose and for easier placing in narrow walls and around reinforcement, even when not specified, on account of the labor saved.

"When concrete is transported in cars, or carts, the lime in the mix is a great aid, as there is not the separation of the aggregate from jarring, as is the case when no lime is used.

"The contract will require more than 100,000 cu. yd. of concrete, practically all of which will contain hydrated lime. Up to the present time over 1200 tons of lime has been used in the work, and about 400 tons more will be required.

"The uniformity of concrete on this piece of work and the absence of honeycomb patches can be greatly attributed to the use of hydrated lime. From the contractor's standpoint the additional cost of the lime is greatly compensated for by the saving in labor in placing the concrete and absence of rocky places to be cut out or plastered up when forms are stripped."

The question may arise as to what effect hydrated lime has on the strength of concrete, and to this there can be but one answer. The Bureau of Standards, in Technologic Paper 58, states:

"The compressive strength of concrete may be reduced by the use of an excess of water in mixing to a fractional part of that which it should attain with the same materials."

It will therefore be seen that by preventing segregation hydrated lime must be regarded as being a material that will have no other effect than to increase the strength of the concrete.

Particular attention is called to Mr. Hackley's statement that hydrated lime has been used in portions of the work, even where not specified, on account of the labor which is saved.

Mr. Johnson, in his article, makes certain recommendations for overcoming the poor practice by running the excess water, together with the fine cement, off through holes in the form boards, etc. Would it not be considered far better and more effective to eliminate the root of the evil—that is, the desire on the part of the concreting foreman to use more water—and especially

so since it can be done effectively and with very little, if any, increase in the cost per cubic yard of concrete?

HYDRATED LIME BUREAU,
Pittsburgh. Norman G. Hough, Manager.

SIR: I have read with a great deal of interest the letter to you from Edward Godfrey relative to Nathan C. Johnson's article on "Water the Chief Factor in Making Good Concrete," and Mr. Johnson's reply to the same, both of which were published in your issue of Feb. 24. It appears to me that both parties agree that excessive water in mixing concrete is detrimental to the material and that only enough water should be used to give a dense, homogeneous mass which will flow freely around the reinforcement and completely fill the forms at all points. I gathered the same impression from Mr. Johnson's original article in your issue of Dec. 30, 1916, and my own experience in concrete work bears this out.

The point that interested me most, however, was Mr. Johnson's statement relative to the 1½-minute mixing period, as recommended by the Joint Committee, and as to how many members of that committee are requiring this in their specifications. During the last year and a half I have written the one-and-a-half period of mixing into all my specifications and have personally seen to it that this provision has been lived up to by the contractors doing the work. For five years before that I followed the same practice on force-account work with very good results—insisting, of course, upon the proper consistency of each batch of concrete that was turned out.

It would be very interesting to know just how many engineers follow this practice and how many do not. I sincerely hope that all members of the Joint Committee will answer Mr. Johnson and let us all know what they are doing.

W. N. JONES,

St. Paul. Designing and Constructing Engineer.

Are Engineers Professional Men?

SIR: I have read the extracts from Professor Newell's address in the Engineering Record of Jan. 27, page 146, and your editorial comments thereon. That Professor Newell should propose a preposterous definition of the term professional engineer to fit his assumptions and arguments is sufficiently surprising; that the Engineering Record should editorially sanction and approve such a definition is little less than astonishing.

Professor Newell lays down two criteria for distinguishing the professional engineer from the non-professional engineer—the relation to the client and the manner of compensation. If the engineer is "his own boss" and calls his compensation a fee or an honorarium he is entitled to be regarded as belonging to the profession; if he works under the instruction of a client and accepts a stipulated rate of "wages" he is not a professional engineer. He is merely a skilled mechanic.

According to this definition there are very few professional engineers. General Goethals was appointed by, and built the Panama Canal under the control and direction of, the U. S. Government, and he received a stipulated salary. The distinguished and veteran engineer who designed and built the Hell Gate Bridge did the work in the employ of a railroad company and under its general direction, and received, no doubt, a liberal "hon-

orarium" at stated periodic times. According to Professor Newell's proposed dicta they are both outside the pale of the profession.

In fact, the number of engineers who dictate to and control clients in the autocratic manner the professor speaks of, and are actuated mainly by altruistic motives, is so small as to be negligible. This is practically as true of the doctors and the lawyers as of the engineers. While actuated by high motives and conforming to high standards of honorable conduct, the simple fact is that they are, like other people, working for a living—and it is no discredit to them. Nor does the fact prevent them from being honorable members of their profession.

Considering the facts as they actually exist in engineering practice one wonders just where Professor Newell would draw the line between a fee or honorarium and a salary; or to what extent the engineer must be under the control of the client to shut him out of the profession.

The proposal of Professor Newell to read out of the profession the great majority of the able and honorable engineers of the country in order to justify his views on publicity and on making the professional societies employment agencies for their members will certainly be resented by the vast majority of those he proposes thus to serve. Most of these societies were organized and so far have been conducted with a higher motive than the promotion of business engagements. The constitution of the American Society of Civil Engineers states its objects to be "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members." Shall we amend it by adding *and the laudatory advertisement of its members and procuring for them of profitable engagements?*

To a certain extent and in a proper manner an engineering society may advance the business of its members by promulgating correct ideas of the high character, ability, honor and fitness to be trusted in public or private enterprises of the members of the profession generally. But it will be a sad day for these societies when they give the public reason to infer that one of their prime purposes is to promote the business interests of their members.

Professor Newell refers to the professions of medicine and law. What would he think of their national organizations if they made it one of their avowed purposes to procure patients and clients for their members?

If engineering is ever to merit recognition as a real profession the line between legitimate professional activities and the promotion of personal business interest thereby must be even more closely drawn than it is now. There must come to be either a true profession of engineering or an organization something like a guild of scientific, skilled mechanics and specially trained business men.

Engineers themselves must decide the question which of the two it shall be.

New York City.

S. WHINERY,
Consulting Engineer.

SIR: To the vast majority of men that make up the rank and file of the engineers of this country the article in the Engineering Record of Jan. 27, abstracted from an address by Prof. F. H. Newell, giving a definition of a professional engineer, coming as it did on the heels

of the report of the American Society's Committee on Compensation, cannot but be discouraging. It was bad enough for a technically trained man to be told that the average compensation for engineers was close to \$4,000 a year, and that if your compensation was not included in that average you could not be considered a regular engineer; but to have the next issue come out with the statement that as long as you worked for wages or a salary, as the case might be, you could not be considered a professional man is to make us wonder whether, after all our years of preparation, we are to be relegated to the mechanic's class simply because we are forced by necessity to work for wages rather than open an office and starve.

The majority of engineers, the men who do the field work, drafting, designing and preparing of reports and budgets, seldom get a chance to see a \$4,000 engineer except at lectures and other side shows, and to tell them that they really are not fitted for their jobs, when they are able to direct a field party or design every detail of a construction job, is a trifle too bizarre to be taken seriously. To be told that a county surveyor or engineer who happens to be on the winning side long enough to hold his job five or six years, or a man whose sole stock in trade is a Jacobs staff, mountain transit, office desk and limited knowledge of land surveying, is entitled to be called a professional man, while the technically trained, experienced governmental or railroad employee is still in the mechanic's class, is, to put it mildly, a bitter dose to swallow.

Professor Newell's definition of a professional man—that none are eligible who receive orders or a salary—would exclude from membership all railroad engineers from chainman to chief engineer of the system, all city and state, all governmental and Army engineers and, indeed, all who are not in the one class of consulting engineers. Even among the lawyers the brightest stars of the guild would be excluded under a strict interpretation of the definition, since they certainly receive regular retainers at stated intervals.

As for the technical difference between dictating and being dictated to, is a man less dictated to when his orders are to secure a piece of property in a legal way than when his orders, originating from the same source, are to build a railroad or erect a building on this same land? It would seem to be a distinction without a difference. But even so, the fundamental difference between law and engineering would seem to necessitate a broader application when applied to engineers, since the doctor and the lawyer may look upon every human being as a possible client, while the engineer must deal only with those who possess property or money, since he cannot work without something tangible to work on. The dictionary defines profession as "a vocation," and since it is impossible to conduct an efficient engineering practice without the aid of salaried men who are technically trained in this particular vocation, let us keep our dignity, at least enough to take pride in our "professional" accomplishments.

If the member of the profession who possesses sufficient executive ability and salesmanship to provide himself with an office desk and a stenographer really wants to be differentiated from the salaried man, let him choose a different title. The lawyer calls himself counsel or the doctor a specialist after he has elevated himself to the high-retainer class, but let the rest of us dub ourselves

professional engineers when our life vocation is professional engineering, even though our emoluments may be derived from the lowly pay envelope.

HAROLD A. THACKRAY,
Engineering Department, Chicago & Western Indiana
Railroad.
Chicago.

SIR: I have read the article by Prof. F. H. Newell in your issue of Jan. 27, together with your editorial comment thereon.

I cannot agree with you in your definition of what constitutes a "professional man." Why should a man cease to be a professional man because he receives a certain fixed sum per month or per year for his services instead of such fees as he sees fit to accept for those services from time to time?

I presume that Professor Newell receives a yearly salary as professor of civil engineering at the University of Illinois. According to his own definition he is not a professional man, and yet I cannot conceive any occupation more truly professional than that of teaching the profession of civil engineering.

I have a friend who is chief surgeon for a large industrial corporation. His work takes all his time and that of several assistants. He receives a salary—rather a large one. Is he not as truly a professional man as when he was in general practice, and accepted a fee for each visit, probably making considerably less money?

Would not a better definition of a professional man be something like this: "A man who practises an occupation requiring technical mental training rather than manual dexterity or commercial acumen"?

ARTHUR D. STIVERS,
Pittsburg, Tex. Consulting Engineer.

[Copies of the foregoing letters were referred to Professor Newell, who answers them as follows.]

SIR: The increasing interest which is being taken by engineers in the present status of engineering and of engineering organizations is indicated by the letters above quoted and by others which have been received personally, following the appearance of the article on page 146 of the Engineering Record of Jan. 27.

The main point of the article, and the one which should be emphasized, is that each engineering society, to perform its full functions, must have clearly in view the character and aspirations of the great body of its members and must shape its actions to meet the needs of these members. If the majority of the membership consists of young or middle-aged men who occupy the great intermediate ground of engineering employees, the society is obviously not performing its best functions for this majority if its efforts are concentrated on details which are of value to a relatively few of the older or more influential men. It makes little difference whether we class these few as professional men or whether we designate as professional all engineers who are not engine runners or mechanics.

No two men will readily agree as to where to draw the exact line between the engineer who is a true mechanic and a man who is generally known as a member of the engineering profession. Between these two extremes are thousands, or even tens of thousands, of men faithfully and efficiently occupying subordinate posi-

tions, from which they may advance, but never to the broad, independent status. These men are, and should be, the bone and sinew of the engineering organizations. Are they fully recognized as such? On the contrary, are their needs not being generally overlooked in the effort to aid the professional minority?

Some of our larger associations of engineers have been conducted apparently from the viewpoint of the relatively few professional men who have attained conspicuous rank. They consciously or unconsciously impose their standards or ideals upon the mass of the membership. While these in themselves may be excellent, yet there is a large probability that they will not fit the common need nor serve as a stimulus. Such societies are valuable in reaching say 40-per cent efficiency, but after they have attained a certain stage they by their very existence check farther development toward an attainable 100-per cent efficiency. Many, appreciating this fact, are discussing the conditions with a view to bringing about such modifications as will correct the present somewhat anomalous conditions—with the result of either essentially modifying the present organizations or providing others which will more nearly fulfill the needs of the great body of assistant engineers or employees in engineering work.

We as engineers do not gain any particular honor by desiring to call ourselves professional men or to shape our societies in the stereotype form of professional societies, any more than our brothers are dishonored by being called mechanics and forming effective unions. Each and every man has his proper sphere of action and is entitled to all the consideration due to his age and character, whether he falls in the group of mechanics, or of professional men, or of any other classification. Whatever the proper division in which his lifework puts him, he is entitled to unite with his fellows and promote the highest interest of that group. If he is a mechanic he has the right and duty to become a member of a labor union and to advance the highest ideals of that union, since under present conditions that is the way he can register his influence. If he is a professional man he should join a body of professional men. If he belongs to a group which does not fall under either designation, he has the equal right and duty to association with other men similarly situated under a form of organization which will advance the common interest. The principal thing, as above stated, is properly to classify the groups, irrespective of the names given them, and to study the needs and opportunities of each group.

Taking up some of the assertions in the letters, it is not apparent as to why any engineer should be discouraged if, under the general definition of profession, he does not fall within this grade. Nor does it necessarily follow that if a man is not grouped among the professions he must necessarily be a mechanic. Both are honorable occupations, and there are others equally honorable which are neither mechanical nor professional.

Among these groups, for example, are large numbers of engineers engaged in the public service. They can hardly be said to be professional men in the commonly accepted use of the word, nor does it particularly matter. The men in this large group, to be more efficient, should be able to meet together frequently and discuss

matters of common interest, increasing their acquaintanceship and strengthening their ability for good.

As regards the criticism of the definition of a professional engineer and suggestions for improving the definition, it may be said that the definitions given on page 146 are not of my devising, and are simply compilations from various sources. Each of us can write his own definition of professional engineer, one which may satisfy him, but this may not be understood nor accepted by the great body of thinking people.

To those men who have ambition to be classed as a member of a profession, there can be only one answer—namely, to wish them success. But, on the other hand, the same good will should be manifested toward the great body of engineers who are not professional men. If they desire to form an organization which, as suggested by Mr. Whinery, may be something “like a guild of scientific, skilled mechanics and specially trained business men,” they should be encouraged to do so, as this will include the great body of men engaged in the practice of engineering.

Such men can and should have ideals as high and a code of ethics as far-reaching as that of any professional organization. More than this, they can and should do everything within their power to promote the advancement of engineering knowledge and practice and the maintenance of a high standard among their membership. This is not incompatible with their filling, at the same time, some of the great needs now experienced—namely, studying the methods of employment and devising more scientific and businesslike ways of getting the round pegs into the round holes and the square pegs into the square holes. Such a body can also educate the public in the need of trained men and of better engineering; can emphasize the need and possibility of better roads, better water supply, better sewers and innumerable other items in which engineers are skilled. They can and should, through their organization, take an active part in discharging their duties to society in general, in seeing to it that better laws are enacted, and they can and should adopt or hold before the members the highest code of ethics.

F. H. NEWELL,

Professor of Civil Engineering, University of Illinois.
Urbana.

Natural Cement for Cobble or Brick Gutters

SIR: I should like to know if any of your readers have tried using natural cement in the construction of cobble stone or brick gutters. I have a considerable length of gutters to protect and wish to do it at as little cost as is consistent with good results.

R. T. BROWN,

Board of Road Commissioners, Davidson County, North Carolina.
Lexington.

Kansas University Extension Staff Engineers

University extension staff engineers in Kansas furnished plans, specifications or other information for road, bridge and drainage work of a value exceeding \$2,000,000 during the biennial period ended June 30, 1916.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Concrete Blocks Cast with Nail in End Spread Narrow Wall Forms

By J. D. TULLER

Superintendent, Louis J. Sieling, Engineering Contractor,
New York City

A NUMBER of 4-in. walls built in connection with a concrete bridge at Holyoke, Mass., constructed during the past season, required forms so close together that the ordinary wooden spreaders were not easily pulled out as the concrete was brought up. To overcome this, the writer made concrete spreaders which could be left embedded in the wall. The forms for these spreaders were easily made by laying a number of 2 x 4s on edge on a platform, 4 in. apart. Between these at intervals of 2 in. short pieces of 2 x 4 4 in. long were placed. This formed a series of pockets 2 x 4 x 4 in. into which mortar was poured. While this was still soft an 8d. nail was placed head down in each section, leaving about $\frac{1}{2}$ in. of the point projecting.

In erecting the forms, the back was put up first and then the reinforcing steel was placed. Next these concrete blocks were placed in position by driving them and forcing the spike in the end of each into the back form. This held the blocks in position until the front form was placed. The forms were thoroughly wired and the concrete poured, the spreaders of course forming part of the wall. The ends of the nails were cut off at the time the form wires were cut.

Small blocks of concrete were made in the same way and used as chairs for the reinforcing in floors and stairs. A short piece of small wire was embedded in each block intended to support the stair reinforcing and used to tie the blocks to the rods to keep the blocks from dropping out when the reinforcing was jarred by walking on it or placing concrete.

Light Traveler Wrecks Bridge During Zero Weather in Race Against Rising Lake

By LOUIS G. ARNOLD

Assistant Superintendent, Wissota Dam, Chippewa Falls, Wis.

THE INSIDE traveler shown in the photograph, which moved on four timber dollies, one at each corner, dismantled a 137-ton steel highway bridge in 13 days. The bridge, which crossed the Chippewa River near the mouth of the Yellow River and about 3 miles above the new Wissota dam of the Wisconsin-Minnesota Light & Power Company, had to be removed and replaced at another location because of the completion

of the dam and the filling of the storage reservoir. The removal had to be completed in 30 days, as the water rose rapidly. The work was the more remarkable because the steel was dismantled in condition to be re-erected and because operations were hampered by extremely cold weather and by the necessity for maintaining traffic during a part of the time.

The bridge, consisting of two 240-ft. spans, 35 ft. deep, carrying a 16-ft. plank roadway at an elevation 33 ft. above the old low-water mark, was supported on 22 three-pile falsework bents with plank and pole sway-bracing. This was placed by framing and stacking the bents for one span on the ice directly under the bridge and raising them into position with tackle, the piles sliding through holes cut in the ice directly under each floorbeam. As the river bottom was coarse gravel, no mud sills were required, the individual length of each pile being determined by actual measure-

ment. The piles were forced to a firm bearing by screw jacks placed under the floorbeams. Filling of the reservoir had been in progress for some time previous to the erection of the falsework, and the ice surface had risen at the rate of about 1 ft. a day. By the time the bents for the second span were ready, the ice was within 12

Don't Stop

SENDING IN your "Hints" with the idea that this section will be discontinued after the consolidation of the Engineering Record with the Engineering News on April 5.

NOT MUCH! With your help, the Engineering News-Record will keep right on publishing

HINTS FOR THE CONTRACTOR



TIMBER TRAVELER REMOVES 480-FOOT STEEL BRIDGE IN THIRTEEN DAYS

ft. of the floorbeams, which caused some difficulty in raising the 40-ft. bents to support this span.

The traveler was erected at one end of the bridge, and the interior struts and swaybracing were removed to the first panel point in the top chord. The trusses were then jacked up at the end and the top-chord pins driven out. After the first pin was removed the rest of the span was readily dismantled. As soon as one panel had been removed, the traveler would be pulled ahead with tackle to the center of the next panel.

The totals of the items shown in the table of the cost of the work are higher than would usually have been

ESTIMATED COST OF THE WORK

Hauling tools and material to job	\$84.75
Hauling piles and bracing to job	318.00
Building falsework	646.00
Falsework, timber and pile material	744.37
Building and wrecking traveler	134.00
Material and tools for traveler	194.87
Wrecking, painting, hauling and storing 137.2 tons steel-work	674.90
Miscellaneous tools	146.33
Camp maintenance and building (6 weeks)	51.12
Camp equipment	86.84
Tool house	18.06
Transporting men to work	147.50
Cutting ice away from falsework (labor only)	227.60
Miscellaneous labor	35.08
General expenses	184.00
Total cost	\$3,693.47
Salvage	464.70
Final cost	\$3,228.77

the case on account of the cold weather. Moreover, none of the men employed were familiar with bridge-erection work.

The filling of the pond exceeded expectations, and, all things considered, rapid work was done in removing the steel before the ice and water reached the floor system. Only 30 working days were required for the entire job, and all the steel was removed in 13 working days.

Well-Drill Holes Should Be Shot Soon, But Not Too Soon

By EDWARD W. GOLDEN

H. W. Golden & Son, Inc., Troy, N. Y.

ON A RECENT CONTRACT considerable experience was secured with well drills used on a sidehill embankment of blue clay and hardpan with plenty of stones. The material being too hard and tough for economical handling with a steam shovel, blasting was resorted to. Holes 3 in. in diameter were drilled to a depth of 25 ft.

To work these drills to best advantage they must be set nearly perpendicular. Runways had to be cut on one side or built up on the other, and great care was required in moving over them. It takes so much time to lower the guides that it is usual to move a drill in working a trim. In the case of drills moved and operated by a tractor special care was required, much maneuvering being necessary to get the drill and tractor in line so that the drive belt would not jump off.

Small stones falling from the sides and collecting under the drill often greatly retarded progress, even though the material was of such a nature as to maintain the shape of the hole. Large stones also caused much trouble, as blasting to crack them and make a cavity into which the drill could force the fragments sometimes loosened stones in the sides of the hole and choked it to such an extent that it had to be abandoned.

The blasting was done by lowering a stick of dynamite into the hole and covering it with mud before firing.

In bad weather it did not pay to let the holes stand too long before shooting. Even ground water sometimes loosened the sides of the holes, so that a great portion of the work was lost by caving. More than half of a 20-ft. hole was so lost on one occasion. On the other hand, if the charges are fired while the drill is near by, the explosion may close the hole on which the rig is working with the drill in it. Though it is not good policy to shoot too close to the shovel, it is sometimes worse to shoot too far ahead. On one occasion a number of holes were shot some time before the shovel could reach that section. In the meantime heavy rains occurred. Each one of the exploded holes acted as a sponge to collect water and hold it. When the shovel did reach this section, one of the worst mud holes imaginable had to be dealt with. The material was not only expensive to excavate, but it was almost impossible to get a bearing on it that would support the shovel.

Two Air Tools Remove and Clean 250 Paving Brick an Hour

By C. G. CUMMINGS

New York City

A PORTABLE gasoline-engine-driven compressor outfit supplying two small drills has been used by C. F. Crowley, Commissioner of Public Works of Troy, N. Y., to tear up brick pavements and clean the brick at a total cost of \$5.96 per 1000, compared with a cost of \$24 per 1000 for doing the same work by hand.

The outfit used is a single-stage 15-hp. Sullivan air compressor supplying a 25-lb. plug drill and a hand-bushing tool of the same manufacture. The plug drill is used for tearing up the brick and the lighter tool for cleaning the old grout from them. Old pavements can be torn up at the rate of 4 sq. ft. in 15 minutes, taking out one brick at a time or prying up several at once, as desired. Breakage is stated to be much less than



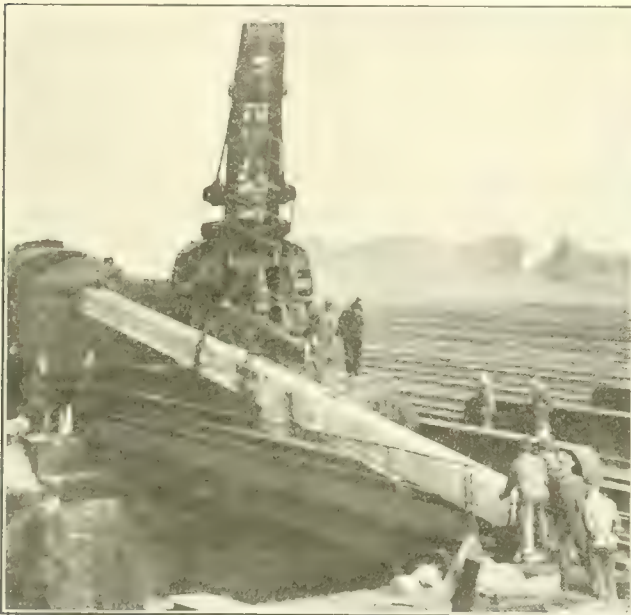
AIR TOOLS REMOVE BRICK WITHOUT BREAKAGE

when the work is done by hand. Previous to the development of this method it took 10 men to tear up and clean 1000 brick per day at a cost of \$24. The operation of the compressor outfit, including oil and gasoline and the wages of an engineer and four workmen, cost \$11.91 per day, and it is stated that the rate of progress with the two tools average 2000 brick removed and cleaned in 8 hours. Since this method was begun 767,000 brick have been cleaned with a total saving to the city estimated at \$13,810. This is said to have paid seven or eight times over for the equipment, which is still in good condition.

Crane Places Precast Concrete Conduit of 50-Foot Span

By F. H. LEWIS
Altoona, Pa.

TO AVOID building falsework and constructing a concrete conduit in place over the Herr Street subway in the Harrisburg yard of the Pennsylvania Railroad, a section of conduit of sufficient length was built



CRANE SETS SECTION OF PRECAST CONDUIT

on a convenient spot near the subway and lifted into place with a locomotive crane. The section of conduit placed in this way, which has a 50-ft. span, is part of an underground system being constructed to eliminate overhead telephone and telegraph wires through a portion of the yard. It was reinforced according to usual practice. After the concrete had been allowed to set for four weeks, the crane picked up the beam, as shown in the photograph, and placed it without difficulty.

Steel Car and Home-Made Tipple Put Cement Into Charging Hopper

By C. LOUIS ZULL
Portsmouth, Ohio

A SMALL steel car running on a four-rail track, with the inside rails bent down at the mixer hopper and the outside rails curled up to catch the rear wheels of the car, was used to put cement in the charging hopper

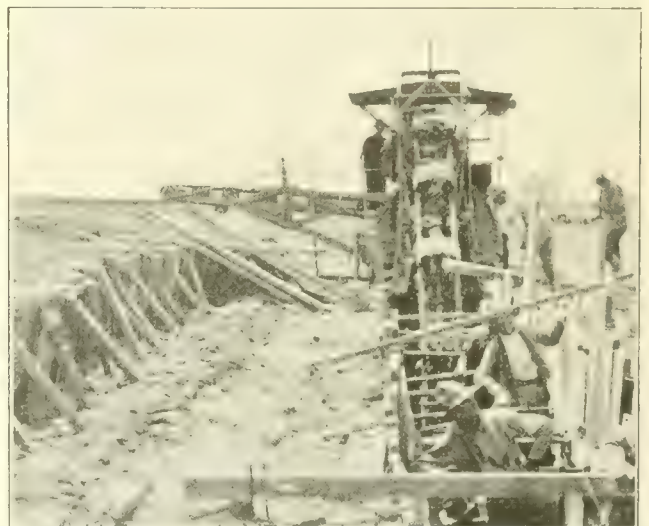
of a concrete plant by the National Contract Company in the construction of Ohio River Dam 35 at New Richmond, Ohio.

The car consisted of a steel box about 2 x 3 ft. and 1 ft. deep, open at one end. This was mounted on four flanged wheels, the two on the front axle being set their thickness inside those on the rear axle. This car ran on a four-rail track, constructed on the charging platform between the door of the cement house and the hopper of the mixer. The outside rails extended out over this hopper about 1 ft. and were curved upward, while the inside rails were bent down inside the hopper. As the car reached the hopper, the front part ran down the inside rails, while the rear wheels caught on the curved outside rails, tilting the car body and discharging the loose cement into the hopper.

Two men emptied two bags of cement each into this car while the mixer hopper was full. As the hopper discharged into the mixer, one man let in gravel for the next batch, while the other drew the sand. The car was then given a light push when the cement was wanted. In this way only two men were required to charge each mixer. The writer was inspector for the U. S. Government on the work described.

Trench Machine Discharges Wet Muck Behind Plank Barrier

WET MUCK excavated for a trench on the Shoshone Irrigation project of the U. S. Reclamation Service was prevented from flowing back into the trench by means of a plank retaining wall, shown in the photo-



MUCK PREVENTED FROM FLOWING BACK INTO TRENCH BY PLANK LEVEE

graph. Sheet piling was placed closely behind the Austin trench machine and the low plank barrier was carried just ahead of it.

High Crowns Are Doomed

It was formerly the rule to build a high crown on an earth road in order to shed water, but now that maintenance systems are being established it is found that a light crown on substantial earth construction is best.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

City Responsible for Safety of Public Buildings

Supreme Court of California Decides Against City of Long Beach in Municipal Auditorium Case

The city of Long Beach, Cal., was held liable by a decision of the State Supreme Court of California on March 2, 1916, for the deaths and injuries that occurred in May, 1913, when the municipal auditorium in that city was wrecked. Thirty-four people were killed and 117 injured when the pier on which the auditorium was erected collapsed. The structure gave way under the weight of 10,000 participants in the British Empire day celebration in commemoration of Queen Victoria's birthday. Accounts of the failure appeared in the News of the Week section of the Engineering Record of May 31, 1913, and on page 628 of the June 7 issue.

Following the accident hundreds of damage suits were filed, in which the total claims amounted to approximately \$1,000,000. Investigation proved that the accident was due to the collapse of a girder which was originally too slender to bear the burdens intended for it and which was almost entirely decayed. The city of Long Beach op-

CONTINUED ON PAGE 445

New York Connecting Railroad Is Dedicated

Impressive Structure Providing All-Rail Route Between New England and the South and West Ready for Operation

Preparatory to the opening of the New York Connecting Railroad for through passenger service between New England and the West and South, the property was dedicated on March 9 to the transportation service of the country by Samuel Rea, president of the Pennsylvania Railroad Company. The special train which conveyed the party of directors and officers of the Pennsylvania, New York, New Haven & Hartford, and Long Island railroads which witnessed the ceremony was the first operated over the new line. It stopped for the dedication at the north end of the bridge across Hell Gate, which, with a span of practically 1000 ft., is the longest arch bridge in the world, and the last portion of the new line to be completed.

The section which is ready for operation, comprising the East River bridge division, was formally turned over by Gustav Lindenthal, its chief engineer and designer, to Samuel Rea, who then transferred it to the New York, New Haven & Hartford Railroad Company for operation as a part of its system.

This section of the New York Connecting Railroad, considered one of the

most remarkable engineering structures in the world, is four-tracked, and includes besides the great arch span $3\frac{1}{2}$ miles of steel viaduct on concrete piers and a mile of line carried on earthfill between concrete retaining walls, which depend for stability on tie rods extending through the fill. The entire road, when the freight branch is completed, will have cost more than \$27,000,000.

Connection Proposed 25 Years Ago

The road, joining the New Haven system at Port Morris in the Bronx and the Pennsylvania system at the Sunnyside yard of the Long Island Railroad, provides direct rail connection through New York City between New England points and the territory south and west of the Hudson River, which was first proposed 25 years ago, when plans were afoot for a railroad bridge across the Hudson River at New York, and when the Steinway Tunnel was first projected. The inauguration of through-train service over this line will eliminate the necessity for transferring through passengers from one railway terminal to another across New York City, which has existed since the



TWO ENGINEERS WHO HAVE FOLLOWED THE PROJECT FOR A QUARTER OF A CENTURY TAKE PART IN OPENING RAIL CONNECTION BETWEEN NEW ENGLAND AND THE SOUTH VIA THE HELL GATE BRIDGE

Insert—Gustav Lindenthal, chief engineer, New York Connecting Railroad, and Samuel Rea, president of that railroad and of the Pennsylvania Railroad Company. Below (prominent engineers numbered) are: 1. George Gibbs, consulting electrical engineer, Pennsylvania Railroad; 2. Samuel Rea; 3. Gustav Lindenthal; 4. E. B. Temple, assistant chief engineer, Pennsylvania Railroad; 5. L. V. Morris, chief engineer, Bay Ridge Improvement, Long Island Railroad; 6. A. C. Shand, chief engineer, Pennsylvania Railroad.

practice of transferring passenger trains by car ferry between New Jersey and the Bronx was discontinued some years ago.

Freight Connection Being Completed

The double-track freight connection of the railroad, extending from a point north of the Sunnyside yard to Bay Ridge, Brooklyn, has been completed, except for one section involving about a mile and a half of construction work near its northern end. This line will make the freight route between New England points and points reached by the railroads entering Jersey City more direct by eliminating the 20-mile ferry transfer up the East River and through Hell Gate. This route, difficult to navigate at all times, becomes dangerous in foggy weather. The new ferry transfer route between Bay Ridge and the Greenville yard of the Pennsylvania Railroad across New York Harbor will be only $3\frac{1}{2}$ miles in length.

New York Engineers Indorse Diplomatic Break

Meeting of American Society Commends Assertion of American Rights and Urges Universal Service

A resolution unanimously adopted at a meeting of the American Society of Civil Engineers in New York City on March 6 last commends the action of President Wilson in severing diplomatic relations with Germany and taking steps to protect American lives and property on the high seas. The resolution further states it to be the duty of engineers to assist the Government by rendering any service of which they are capable as individuals or as a body, and by urging Congress 'to exercise its constitutional power to raise and support armies' by establishing immediately a permanent and democratic system of defense based upon universal service and training under direct and exclusive federal control."

It was ordered that a copy of the resolution be transmitted to the President and members of the Cabinet, and to the members of both Congressional committees on military affairs.

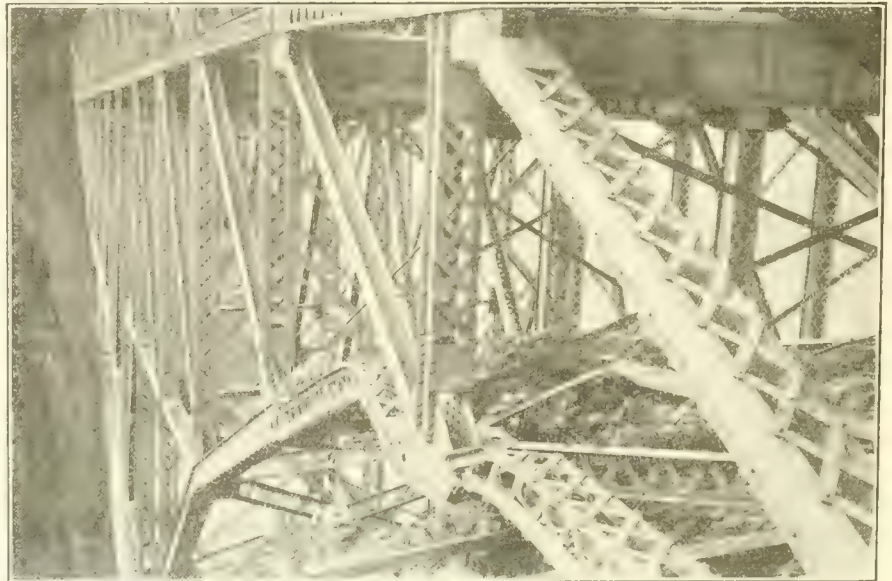
Slide Causes Collapse of Seattle Bridge Approach

Lower Chords of Steel Cantilever Arm Buckled and Whole Structure Displaced—Pier Tilted

An earth slide on the sidehill at the Twelfth Avenue South bridge, in Seattle, Wash., on Feb. 26, caused the collapse of about 150 ft. of the timber approach on the south, badly buckled the lower chords of the steel cantilever arm of the main structure, apparently shifted the latter bodily toward the

out the piers at that end; in fact, the cantilever arms were designed to carry the loading without end supports just to anticipate such slides as actually occurred.

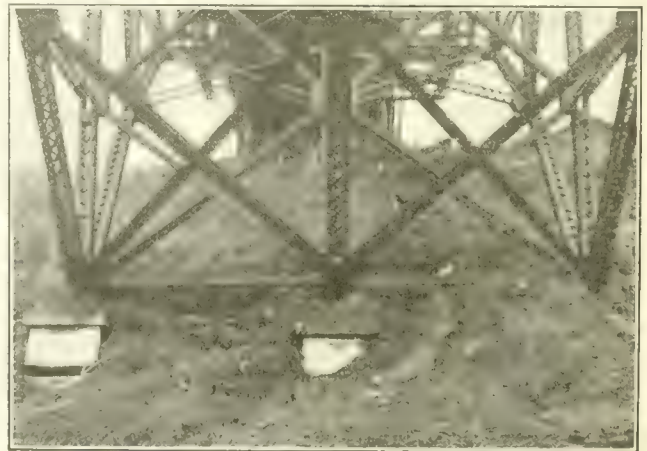
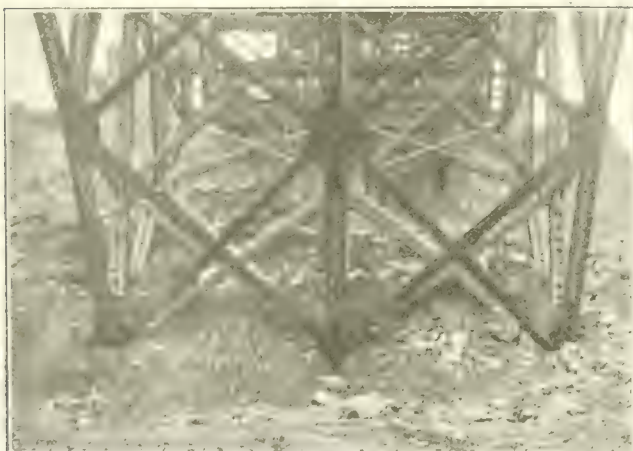
The main steel bridge is still supported on the intermediate concrete piers. The west pier on the north side parted below the anchor bolts at a construction joint, and made an opening in one side of the pier of 13 in., as is seen in one of the photographs. The condition of the other piers is not known, as they are covered with earth. The posts of the timber frame superstructure are



PRESSURE OF SLIDING EARTH BUCKLED THE LOWER CHORDS OF CANTILEVER ARM

north, and caused one of the north supporting piers to tilt open at a construction joint. The accompanying photographs and the following data have been furnished by E. French Case of the Street and Sewer Department of Seattle. Fortunately no lives were lost, as the bridge had been closed to street car and vehicular traffic just one week previous by Charles R. Case, superintendent of streets and sewers, because a slight movement in the street had been noticed. This site is subject to such slides, one at the north end about two years ago entirely carrying

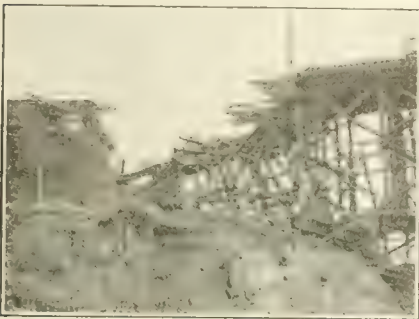
inclined at an angle, showing the movement of the steel portion toward the north. The steel bridge is 361 ft. long, and was completed at a cost of \$80,000 in 1912, as a part of the Dearborn Street regrade. A. H. Dimock was city engineer. The designing was done by J. W. Bowerman, of the firm of Bowerman & McCloy, bridge engineers of Seattle, under the direction of R. H. Thomson, who was then city engineer. Lewis & Wiley were the contractors, and the Penn Bridge Company supplied the steel, amounting to 550 tons.



LEFT—VIEW LOOKING SOUTH SHOWS EARTH COVERING PIERS; RIGHT—NORTH PIER OPENED AT CONSTRUCTION JOINT

The bridge consists of a center span 171 ft. long, and two cantilever arms 95 ft. long at each end. Expansion rollers were used on the south main pier only, and large pins in both main pier shoes were used to permit grade adjustment. Slotted holes and pins were adopted on the two outer panels of each cantilever arm to avoid a continuous structure, and also for the purpose of showing deflections and giving warning as to the condition of the ground on the slopes.

The steel portion of the bridge was built at an elevation of 90 ft above the center of Dearborn Street, and conforms to the proposed regrade of Beacon Hill. A timber frame superstructure roadway was built on the steel at an 8.54 per cent grade, so as to meet the existing streets on each side of the cut. This frame roadway is 395 ft. long and 110 ft. above Dear-



EARTH SLIDE CAUSED COLLAPSE OF TIMBER APPROACH ON SOUTH END

born Street, and is supported by posts varying in length from 5 to 35 ft.

This bridge forms part of the main arterial highway from Beacon Hill district to the heart of the city—a large district covering a number of square miles, and quite thickly populated, with no approach on the west side of this hill to the south, and with only one approach on the north and east side, which is not paved.

Pressure on the steel bridge is being relieved by removing a portion of the slide and the wrecked approach material, which now rests against the members at the south end. It is planned to repair the steel portion of the bridge and to rebuild the approach.

Rhode Island Engineers Classified for National Crisis

The Rhode Island branch of the National Security League, with headquarters at Providence, R. I., has appointed a committee to classify the engineers of the state in order to ascertain how best they can be utilized for the protection and adaptation of the resources of that state in case of a national crisis. The classification is voluntary.

The headquarters of the subcommittee on engineering classification, which consists of William V. Polleys, chairman; Robert W. Adams and Robert L. Brunet, is at 1413 Turks Head Building, Providence, R. I.

City Responsible for Safety of Public Buildings

CONTINUED FROM PAGE 415

posed the damage suits, claiming it was not liable, as no rent had been paid for the use of the auditorium, and also taking the position that the municipality could not be sued.

But the Supreme Court in the decision rendered March 2, which was written by Justice Henshaw, and in which Justices Melvin, Sloss, Lorrigan and Lawlor concurred, decided these points against the city. The court held that while the legislature gives municipal corporations the right to erect and own municipal auditoriums, railroads, etc., it is not a governmental function and they are on the same footing as private individuals. They are responsible for the construction of buildings of this nature and for any accidents that might occur from faulty construction or negligence. The decision was based largely upon a former ruling of the court when it decided that the city of Alameda was responsible for accidents that occurred when it was conducting its own electric-light plant.

Cleveland Acts on Cuyahoga River Straightening

Petitions by County and City for Conservancy Board to Handle Proposition Well Under Way

To facilitate the movement in Cleveland toward getting the Cuyahoga River straightened, the Chamber of Commerce has recommended to the city and county officials co-operation between the city and county in securing the establishment of a local conservancy district. A resolution calling on the river and harbor committee of the city council to consider the advisability of such co-operation was passed March 7. Previously a subcommittee had reported its belief that the purposes of the conservancy act are broad enough to include the contemplated Cuyahoga River straightening project. Any or all of the following purposes which are to be named in a petition for the district will justify the exercise of such authority by the court: Preventing floods; regulating stream channels by changing, widening or deepening; reclaiming wet and overflowed lands; providing for irrigation where it may be needed; regulating the flow of streams, and of diverting or eliminating watercourses.

Advocacy of the establishment of a local district is influenced by the following considerations: That the industrial and commercial development of the river valley district is seriously hampered by the narrow, winding river channel; that flood damage in 1913 amounted to more than \$1,250,000; that no recognized plan of realignment now exists. The plans recommended after the federal survey of 1912 failed to receive approval by the U. S. engineers. In view of the large number of public

and private interests involved, the Chamber of Commerce sees a great advantage in having the problem handled by a body constituted only for that purpose.

The Chamber of Commerce recommended the tentative plan recently proposed by a special committee, consisting of Major Paul S. Bond, Engineer Corps, U. S. Army; W. S. Stinchcomb, county engineer, and E. B. Thomas, consulting engineer and member of the committee on river and harbor improvement, because it realized the advantage of having a concrete proposal by experts as a basis for study.

Engineer Appointments to Reserve Corps Continue

The following is a list of persons whose acceptances of appointment in the Engineer Officers' Reserve Corps, U. S. Army, have been received since the first list appeared in the Engineering Record of March 3, page 363:

Major—Samuel Hamilton Hedges, Washington.

Captains—John Stephen Doyle, Maryland; Ebert Allan Gibbs, Pennsylvania; Arthur H. Pratt, New York; Everett Bodman Murray, Missouri; Walter Owen Washington, Texas, and Willis D. A. Peaslee, Oregon.

First Lieutenants—Francis Olcott Allen III, Wisconsin; Karl J. Zinck, Oregon; John L. Desch, New Jersey, and Walter H. Dunlap, Washington, D. C.

Second Lieutenants—William M. Robinson, Jr., Georgia; Leo E. Fleischman, New York; Frederic W. Olmstead, New York; Paul S. Jones, Oregon; Happer K. Phelps, California; Arthur T. Fulkerson, Indiana; Frank F. Hutchings, Massachusetts; Jacob E. Eckstein, Pennsylvania; John P. Horan, Texas; Quincy Claude Ayres, Washington, D. C.; Gilbert Doolittle, New York; David M. Dunning, Jr., New York; Clay Warden Lewis, Missouri; George Dashiell Camp, Texas, and Edwin Caleb Burt, Washington, D. C.

Engineers of Southwestern States Organize Society

The Southwestern Society of Engineers was organized and a constitution adopted at a meeting in El Paso, Tex., March 8, 9 and 10. The primary object of the new society, as noted in the Engineering Record of March 10, page 404, is "the professional improvement of its members, the encouragement of social intercourse among engineers and the advancement of engineering knowledge, education and practice." The idea of the new organization was fostered rather than the formation of sections of the national societies because in the particular territory covered there are not sufficient members of any one of the national societies to form strong branch organizations, while about 1000 engineers within convenient distance of headquarters can qualify for membership in the new organization.

Flood Protection Planned by Los Angeles County

The plan for flood-protection work in Los Angeles County, California, for which a bond issue of \$4,450,000 was recently approved, as reported in last week's issue of the *Engineering Record*, divides the work into four parts—(1) The construction of dams, both large and small, in the mountainous areas; (2) the protection of the banks of the smaller streams, together with spreading and storing of waters for beneficial use; (3) rectification through river-training and bank-protection of major streams, and (4) protection to the harbors of Los Angeles and Long Beach and their shipping interests.

The most important structures are as follows: On Pacoima Wash, a masonry dam, curved on a radius of 400 ft., 145 ft. high and 478 ft. long on top, with a storage capacity of 3200 acre-feet, to cost \$359,460; a masonry dam at Devil's Gate, 130 ft. high, curved on a 400-ft. radius, to cost \$290,000; the San Dimas dam, also 130 ft. high, and built on a 400-ft. radius, to impound 2500 acre-feet, to cost \$278,000; the Pomona dam, to be of the earthfill type, 3300 ft. long, with a maximum height of 41 ft. The last-named structure will have a storage capacity of 2320 acre-feet.

Of the total bond issue, \$60,000 is allotted to the work of building check dams in 17 cañon not heretofore so protected. The cost in each cañon ranges from \$840 to \$21,300. The harbor protection work is to consist chiefly of dikes and levees intended to confine flood waters to definite channels. Bridges will be built where main thoroughfares cross such channels.

The Board of Supervisors of Los Angeles recently agreed, in case the bond issue carried, to appoint three consulting engineers to review the plans being voted upon, which were prepared by J. W. Reagan, county flood-control engineer. The two of these consulting engineers already named are William Mulholland, chief engineer of the Water Department, and Major G. B. Pillsbury, federal engineer in charge of harbor work.

Discuss City Planning as a Metropolitan District Problem

Considered not as a problem for a single municipality, but rather as an opportunity for co-operation among groups of cities and towns, city planning for the Metropolitan District was the subject of a conference held at the City Club, New York City, March 10. Following an address, in which Nelson P. Lewis, chief engineer of the New York Board of Estimate and Apportionment, outlined the inter-relation of city and town planning, a committee was appointed to report plans for future action at a second conference to be held in a few months. Its members are Nelson P. Lewis and Frank B. Williams for New York City; Herbert Angell, Mount Vernon, N. Y.; Oscar

Maddaus, Mineola, N. Y., and Arthur P. Cozzens, Newark, N. J.

One of the most pressing needs, it was pointed out, is for a comprehensive metropolitan highway system linking New York and New Jersey communities. Scientific planning principles, rather than legislative log-rolling, are needed in the layout of highway systems, according to Harry Meixell, Jr. In the larger cities, according to John T. Fox, transport expert to the committee on city plan of the New York Board of Estimate, too much time and too many changes of cars are required to reach suburban points.

Engineers in Commercial Association Lead in Patriotic Enthusiasm

Group 24, engineers, of the Denver Civic and Commercial Association, is taking the lead in that organization in rendering patriotic service. Sixty of them met recently and of their deliberations the *Commercial* says: "For numbers, intelligent procedure and downright enthusiasm it eclipsed any meeting of the smaller units of the organization that has yet been held."

At the meeting Chairman L. G. Carpenter explained details of the plan to take a human and physical census of the state's war resources. H. S. Crocker, consulting engineer, representing the American Society of Civil Engineers on the state board of directors of the Naval Consulting Board, explained what had been done by his board, and Arthur Ridgeway, assistant chief engineer, Denver & Rio Grande Railroad, told what services the government could expect from the railroads in the event of war.

Upon inquiry it was found that no point nearer to Denver than Kansas City or Yellowstone Park is available for the engineers to take examinations for the Officers' Reserve Corps. It is hoped to induce the War Department to send an examiner to Denver.

Hold Third Conference on Engineering Co-operation

Discussion of fundamentals of engineering co-operation outlined by the committee appointed last year is the object of the third annual conference on engineering co-operation to be held March 29 and 30 in the rooms of the Western Society of Engineers. Prof. F. H. Newell, chairman of the committee, has invited all the engineering societies whose names he could find and he states that none should stand on the formality of invitation, but send delegates.

In the discussion of the subject it will be shown, among other things, that as a preliminary to all efforts toward co-operation among engineering organizations there should be the expressed intent to assist in strengthening and unifying the work of the national engineering societies in the advancement of engineering knowledge and the practice and maintenance of high profes-

sional standards. Invigoration of local autonomous organizations will be shown to be fundamental. Welfare of members, ethics, employment, publicity and civic affairs are to be discussed. The committee believes that intermediate societies have no place, that the public engineer should be furnished sympathetic support, that occasional conferences should be held and that a field secretary should be supported to give personal advice and assistance toward efficiency and economy. The committee has expressed its views and the subjects are up for discussion and possible adoption.

At a dinner to be given March 29 under the auspices of the various engineering societies in Chicago, Hunter McDonald, past president of the American Society of Engineers and chief engineer, Nashville, Chattanooga & St. Louis Railway; C. A. Morse, chief engineer, Chicago, Rock Island & Pacific Railway; H. M. Byllesby, president of H. M. Byllesby & Company, and E. H. Lewis, dean of the Lewis Institute, will speak.

What Engineers and Contractors Are Doing

PAUL GENDELL, secretary of the Dubois (Pa.) Chamber of Commerce, has resigned that post to become superintendent of the employment office of the Emergency Aid of Philadelphia under the joint control of the Emergency Aid and the Pennsylvania Department of Labor and Industry. Mr. Gendell, one of the first engineers to become secretary of a chamber of commerce in Pennsylvania, has directed an industrial census of the entire city. He was manager of the Engineers' Society of Pennsylvania, with headquarters at Harrisburg before becoming secretary of the Dubois chamber. For ten years prior to that he was an engineer with the Pennsylvania Steel Company at Steelton, Pa. C. Lawrence Shepley, city editor of the *Harrisburg Telegraph*, Harrisburg, Pa., has been elected to succeed Mr. Gendell.

CHARLES SAVILLE, spoken of in the *Engineering Record* of March 3, page 333, as State director of Public Health, Texas, is director of public health of the city of Dallas, Tex.

JOHN C. PAYNE, assistant engineer of the Department of Commerce and Navigation, Trenton, N. J., and for many years engineer for the Board of Riparian Commissioners, has been appointed chief engineer of the department, succeeding B. F. Cresson, resigned.

H. S. FORNERI has resigned as city engineer of Eugene, Ore. He intends to open offices in San Diego, Cal.

O. J. DE SPAIN, county engineer, Adams County, Washington, has been appointed city engineer of Ritzville, Wash.

ROBERT L. E. WARD, recently with engineer department, central division, the Great Northern Railway, has accepted a position as assistant engineer with the Miracle Engineering Company of Great Falls, Mont.

WILLIAM R. D. HALL, statistician of the Pennsylvania State Highway Department, has resigned his position and has been appointed manager of the publicity bureau of the Philadelphia Chamber of Commerce. Mr. Hall has been with the State Highway Department since October, 1913, where he was in charge of publicity and editor of the *Pennsylvania Highway News*.

W. A. VANDUZER, assistant engineer of the Pennsylvania State Highway Department, in charge of District 12, comprising the counties of Lackawanna, Monroe, Pike, Wyoming, Wayne and Susquehanna, has resigned his position with the department to engage in private business.

W. H. BIRCHER, of Scranton, Pa., superintendent of Lackawanna and Wayne counties, Pennsylvania State Highway Department, has been promoted to the position of acting assistant engineer in charge of District 12, vice Mr. VanDuzer, resigned. Mr. Bircher has been with the State Highway Department seven and one-half years in various engineering capacities. W. J. Devereaux, of Scranton, Pa., now chief of construction in District 12, has been appointed superintendent of Lackawanna and Wayne counties. Mr. Devereaux has been with the department six years. Edwin Bytheway, superintendent of Lehigh and Northampton counties, has resigned his position and the vacancy thus created has been filled by the appointment of H. G. Fenstermacher, of Allentown, Pa. Mr. Fenstermacher has been with the department for five and one-half years in various engineering capacities.

E. H. SHIPMAN has been appointed chief engineer in charge of engineering construction and valuation of the Lehigh & New England Railroad, with office at South Bethlehem, Pa. Mr. Shipman, who was formerly superintendent of the railroad in charge of operation and engineering, was at the same time connected with the Lehigh Coal & Navigation Company, first as chief engineer on 106 miles of canal and since 1908 as canal superintendent in charge of operation and engineering in the canal department. He is a graduate of Lehigh University, class of 1888, and since graduation has continually been in active engineering practice.

PAUL P. STEWART, chief engineer and treasurer, Ketler, Elliott Erection Company, has been appointed national director of the American Association of Engineers to fill the unexpired term of A. H. Krom, who resigned to become general manager of the association. Mr. Stewart was graduated from Yale in 1902 and for many years was connected with the U. S.

Steel Corporation in charge of design and construction work at Gary, Ind. For a time he was professor of structural engineering at Ohio Northern University.

JAMES P. LOGAN, Newark, N. J., has been appointed member of the Passaic Valley Sewerage and Drainage Commission, to succeed John J. Berry, Newark.

EDWIN H. VERNER, until recently municipal engineer of Port Coquitlam, B. C., Canada, has resigned to take a similar position at Langley, B. C.

BURWELL BANTZ, former county engineer, Island County, Washington, has opened an office in Coupeville, Wash., for the practice of civil engineering.

GEORGE H. DAWSON, surveyor-general of British Columbia, has resigned his position and will resume private practice.

H. J. HARDER, city engineer of Paterson, N. J., has been engaged by the Borough of Glen Rock, N. J., to make surveys and plans for a system of sewers.

R. C. CARPENTER, professor of experimental engineering, Cornell University, reaches the retiring age at the end of the present college year and will sever his active connection with the university at that time. Respecting his retirement, the committee on general administration of the board of trustees has adopted the following resolution: "Resolved, That the trustees in accepting the resignation of Professor Carpenter express their high appreciation of his services to the university for nearly thirty years. As a pioneer in the field of experimental engineering he is held in the highest esteem by all mechanical engineers, and by his writing in this field he has made an assured place for himself in the annals of his profession. As a teacher and investigator he is affectionately remembered by many generations of students and his retirement from the faculty of Sibley College will be viewed with great regret by all his colleagues." Professor Carpenter retires in good health and expects to maintain his activities in the fields of engineering investigation and research for several years to come.

J. J. DWYER, president of the California State Board of Harbor Commissioners, has resigned his office.

John Alden of Puritan fame. He was graduated from the Rensselaer Polytechnic Institute in 1872. Following his graduation he was made assistant engineer in the construction of a bridge to carry the New York Central Railroad tracks across the Hudson River at Albany. In 1875 he became assistant engineer of the Leighton Bridge & Iron Works, Rochester, N. Y., and three years later became chief engineer and member of the firm. In 1880 he entered into partnership with Moritz

Noted Bridge Engineer Dies



JOHN F. ALDEN

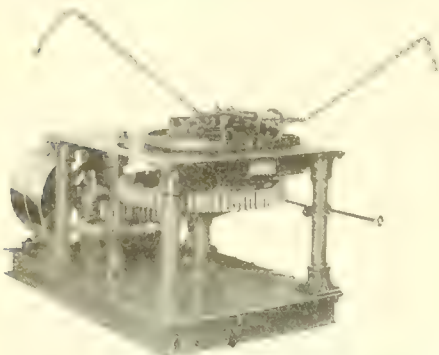
Lassig of Chicago, when the Leighton Iron Works was taken over under the firm name of Alden & Lassig, with establishments in both cities. Later, after Mr. Alden had reorganized his business under the name of Rochester Bridge & Iron Works, of which he was sole proprietor until 1901, he sold out to the American Bridge Company, retaining an interest in the company up to the time of his death. Mr. Alden was connected with the construction of many bridges, especially for railroads. Among his works are sections of the elevated railroad in New York City, many bridges of the Delaware & Hudson Railroad, the Chicago, Milwaukee & St. Paul Railway, and others. He was also connected with the building of the bridge over the Columbia River at Pasco, Wash., and the upper suspension bridge at Niagara Falls. He furnished most of the steelwork at the Columbian Exposition, Chicago. In Rochester he erected, among others, the Driving Park Avenue bridge, which had been twice unsuccessfully attempted by others. Mr. Alden was a member of the Rensselaer Society of Civil Engineers and a former vice-president of the American Society of Civil Engineers, as well as a member of other engineering and scientific bodies.

Obituary Notes

JOHN F. ALDEN, noted bridge engineer and representative of the American Bridge Company, died recently at his home in Rochester, N. Y. Mr. Alden, born in 1852, was a direct descendant in the eighth generation of

Announce New Bar Bender

A new power bar bender, just put on the market, is said to bend bars up to 1½ in. diameter at any desired angle. It has a vise arrangement to keep the rods in adjustment when making more

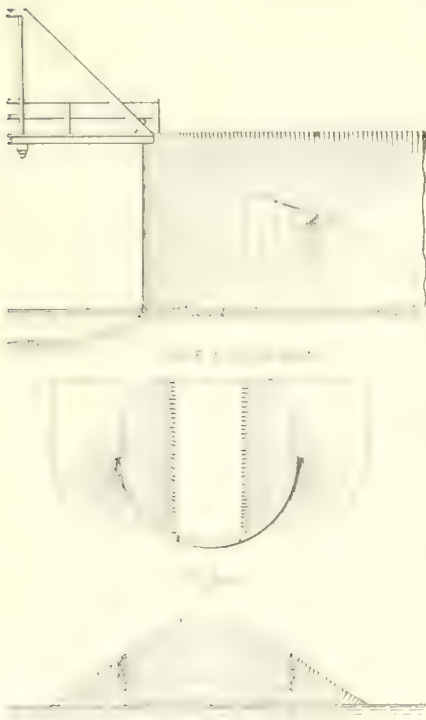


MACHINE SAID TO BEND BARS AT ANY ANGLE

than one bend. All wearable parts are said to be of cast steel, and the machine is arranged for any style of power drive. It is being manufactured by the McKenna Company, 1851 East Thirty-eighth Street, Cleveland, Ohio.

New Type of Abutment Wall Patented

There were constructed in 1912-1913 in connection with the Keokuk dam across the Mississippi River, and under the supervision of Hugh L. Cooper, of New York City, several highway bridges and a new type of combined bridge abutment and retaining wall. Subsequently M. T. Thompson, the de-



TYPICAL PLAN AND ELEVATIONS OF SEMI-CIRCULAR RETAINING WALL ABUTMENT

signer of these semicircular reinforced-concrete walls (typical plan and elevation of which are indicated by the drawing herewith) applied for letters patent, which were granted in September, 1916.

It is claimed that these walls have been entirely satisfactory, that the thickness required is much less than for standard construction, that the pressure of the earthfill is resisted by the weight and anchorage of earth around the rear extension of the wall and that this continuous curved type of reinforced-concrete wall is in no danger from unequal stresses such as often cause rupture in the usual form of abutment at the junction of the front wall and the wing walls. The chief claim made is for economy due to the use of less concrete—walls 28 ft. high and 15 in. thick, and later only 12 in. thick were constructed at Keokuk.

The Thompson Abutment Sales Company, Cuyler Building, New York City, has obtained the sole right to license builders of concrete abutments of this type.

Introduce New Rust-Proofing Material

Announcement is made by Hess & Son, Philadelphia, Pa., of Epicassit, a metallic rust-proofing material lately introduced into this country from Germany. The coating is a metal powder mixed with a liquid carrier to the consistency of thick paint. It is applied with a brush and then melted on with a torch or in a furnace. It is said that the German Imperial Government testing laboratory at Berlin has reported that the material is proof against heat and cold and mechanical abuse, and is non-porous. A bright surface can be obtained by wiping the molten coating with a greasy cloth.

Form New Contractors' Equipment Company for Chicago

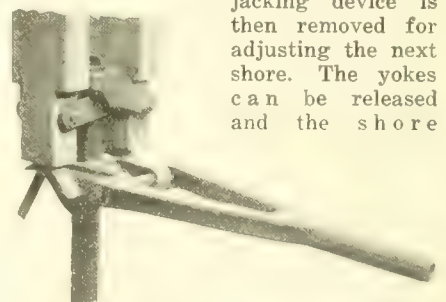
Mays & Talley, formerly agents for the Milwaukee Concrete Mixer Company, have combined with Walter B. Louer under the firm name of W. B. Louer Company, contractors' equipment. The offices of the new firm are on the ground floor of the Old Colony Building, Chicago, and have space to stock small parts and keep on hand a number of pumps and mixers. They will handle the Rex mixers, Pulsometer pumps, Novo engines, hoists, pumps, Parsons trench machines and backfillers, Lambert hoisting engines, Owen buckets, and a complete line of smaller supplies, such as hose, wheelbarrows, derricks and wire rope. The organization will have a permanent office in the Penobscott Building in Detroit, whose territory will include Illinois, northern Indiana, eastern Iowa and Michigan. There will be six salesmen assisted by two expert service men, who will devote their entire attention to the mechanical operation of machinery sold.

New Shoring Device Used on Concrete Formwork

A new self-locking, adjustable shoring device used in concrete construction is being manufactured by the H. W. Roos Company, Cincinnati, Ohio,



SHORE IS SELF-LOCKING



FINAL POSITION OBTAINED BY JACKING DEVICE

which, it is stated, can be quickly set up and adjusted and later taken down by an unskilled laborer. The shores can be used repeatedly, are non-slipping and can be adjusted to any required height. As constructed for the average use, the shore consists of a 7-ft. lower member of standard pipe and an extension member of two legs of 2 x 4s, 8 ft. in length, with clamping yokes attached, the latter engaging with the pipe. This gives a shore adjustable from 8 ft. to 14 ft.

A jacking device permits of fine adjustment and a setscrew locks the yokes and prevents any possible release through outside jarring. The jacking device is then removed for adjusting the next shore. The yokes can be released and the shore

taken down by loosening the yoke setscrew and tapping with a hammer on the yoke collar.

The price of the shore is \$5.50 or \$6, according to the length. The jacking device costs \$5.

Trade Publications

International Harvester Company of America, Chicago. Almanac for 1917, 40 pages, illustrated.

Yeomans Brothers Company, Chicago. Bulletin B-3000, describing electric bulge pumps.

Victor R. Browning & Company, Cleveland. Folder describing single I-beams hand traveling cranes.

Engineering Record

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Number 12

Eight-Hour Law

THE "eight-hour law" is constitutional, and the right of Congress to regulate wages has been established—established, it is true, by the narrowest possible majority in the Supreme Court, five to four. Casting aside all of the constitutional and legal lines of argument along which this controversy may be pursued, and looking at it from the standpoint of common sense and recent tendencies, it was inevitable that eventually it would be decided that Congress had the power to regulate wages on interstate carriers. By a long series of enactments the government has come to exercise most complete control not only over every item of service, but also over rates. It sets the income that shall be allowed and the service that shall be rendered for that income. Outgo has been affected by the service requirements placed on the carriers. To us it seems, stripped of the legal controversies, but a short step to curtail that outgo still further by setting the wages of the men. Moreover, if the government shall say what the railroads shall earn, how can it refuse to fix the wages that the men shall have, when those men are so organized that they can enforce their demands against the railroads or tie up the country? Under the circumstances no other ground than wage control seems tenable, and in saying that we are fully cognizant that our positiveness is not justified by the narrowness of the majority in the Supreme Court supporting the measure. It need hardly be said, of course, that we heartily disapprove of the manner in which the wage increase was secured—by "holding up" Congress, and, without investigation as to their ability to pay, laying an additional financial burden on the railroads. It is unthinkable, of course, that Congress will permanently exercise its wage-fixing power. Undoubtedly it will delegate authority to the Interstate Commerce Commission, and we shall expect from that body a careful study of the finances of the carriers before imposing new burdens. Finally, the right to fix wages having been sustained, but one more step remains—to require compulsory arbitration, or at least a statute preventing a strike while a controversy is under investigation. That the right to compel arbitration is bound up with that of fixing hours and wages is plainly stated by the chief justice in these words: "Rights are necessarily subject to limitation when employment is accepted in a business charged with a public interest." This part of the decision is not welcomed by the brotherhoods, but they illogically have sought the rewards but hoped to escape the responsibilities.

The Engineer Salesman

FOR YEARS manufacturers of electrical and mechanical equipment have put young engineering graduates through their factories and organizations in order to train them for their sales forces. The plan has proved very successful and is the established means of recruiting sales forces in high-class organizations having a technical product. It is interesting to note that our foreign trade expansion is forcing organizations which desire to sell technical products abroad to adopt similar training plans. In an article in the current issue of *The Americas*, S. T. Henry describes the methods that the machinery-selling organizations of the American International Corporation propose to apply in their work of extending the use of American machinery in foreign lands. Not finding available a force of men familiar both with American machinery and with foreign languages and trade customs, they are taking young engineers, putting them through the shops where the equipment to be sold is fabricated, and then, after a further course in the New York office of the company, sending them abroad. The wisdom of this policy is so patent that it need not be argued here. It may be pointed out, however, that the work of these young men when they reach their foreign posts is not merely to effect sales, but to show foreign engineers, constructors and manufacturers how American equipment can be used to advantage. This educational feature of their work will be particularly emphasized in connection with American construction machinery, which has very limited application abroad at the present time, and the tremendous possibilities of which in cost-reduction are not even remotely sensed. Since the war began this journal has repeatedly referred to the enlarged field which our expanding foreign commerce and investments are creating for the American engineer. To the fields already pointed out is now added the very attractive field of engineering salesmanship.

Engineering Co-operation

CO-OPERATION between engineering societies has been the subject of frequent discussion in recent years. The results to date may be somewhat disappointing, considering the amount of thought devoted to the subject. Yet most engineers, we believe, will concede that the discussions have helped us to clarify our ideas and to learn, at least, some of the things not to do. Eventually, and very shortly, we hope, machinery will be perfected by which all of the local engineering societies will work together. In national bodies the

progress has been very considerable and discussions are under way which should result in a wider participation by them in affairs of a public character. For a basis for discussion on this subject the reader is referred to the report of a committee prepared for the Third Annual Conference on Engineering Co-operation to be held in Chicago next week, printed elsewhere in this issue. Space does not permit of discussion here of the various proposals made. Particularly are those to be commended which refer to the conduct of local organizations. Not enough attention has been given in a broad way toward strengthening the local societies, and in the last analysis these are the bodies which will have direct contact with the public. The larger organizations can speak on national topics, can guide and inspire the local bodies. They are to be compared, however, to the headquarters of an army, the local societies being on the firing line. Efficiency is needed in both places. So far, the headquarters organization has made the greater progress. Not until the fighting units are equally well taken care of, however, can the profession exercise its greatest influence.

State Control of Bridge Construction

IN the closing pages of the "Bridge Manual" recently issued by the Oregon State Highway Commission, prepared under the direction of John H. Lewis, state engineer, there is given a summary of the present situation in regard to bridge legislation. It is stated that only four states have no organized highway commission—Georgia, South Carolina, Texas and Indiana. In fifteen states plans and specifications for strictly county bridges are prepared by the state on request, while in five states plans and specifications prepared by the state are obligatory on the counties. In six states plans may be submitted for approval at the option of the counties and in eight states they must be submitted to the state for approval. In four states these plans and specifications are drawn up by the counties, following standards prescribed by the state, and in seven states the counties have absolute control. In Illinois the loading of county bridges is prescribed by law, and the Minnesota law demands the annual inspection of all bridges by the highway commission.

The object to be attained by the publication of bridge manuals in which best standard practice is illustrated for the purpose of co-ordinating and unifying the design and construction of bridges and culverts throughout the state is certainly to be commended. It is evident that the extent to which state control and supervision should be carried is widely different for different states. Central control, if competent, should lead to economy in many ways, the most important of which lies in reduced contract prices by bridge companies, due to the fact that they know exactly what they have to furnish and are not forced to make many alternate designs, which heretofore have been a prolific source of waste in time and labor in estimating departments. Not only is greater economy attained, but the standardization of plans archi-

tecturally and structurally can be made to anticipate future traffic conditions in a reasonable and conservative way.

In one respect the practice of state control has not yet been carried far enough. By furnishing free plans and specifications, or approving estimates and designs, the state commission is responsible only for the paper details—the actual construction in the field may be wholly unsatisfactory because of the failure of the contractor to do his work properly. Supervision by the state should be exercised over the actual construction work, either by inspectors furnished by the commission, by instructions issued to county inspectors or direct control over such inspectors. Actual cases of friction between county and state have occurred because of failure in execution of standard state plans. Complete control and standardization are possible only when measures are taken to have actual construction done in accordance with the plans and specifications.

Engineering Estimates and Research

ARE engineers too optimistic in designing their work and in their estimates of time and cost? This was a question discussed by Sir Maurice Fitzmaurice in his installation address as president of the Institution of Civil Engineers. The address is well worth reading for its sound and thoughtful discussion of the obstacles to success in engineering. Answering the question, he says that engineers must plead guilty to the charge—sometimes at least—and then he explains how and why. His chief points are that engineering is not an exact science; that allowances must be made for lack of information and for contingencies; that the client considers the allowances of the careful engineer excessive, and insists that the unknown factors be regarded favorably rather than as having an even chance of happening, or not happening; and that the engineer reluctantly finds himself forced to reduce his estimates of money and time. In other words, it is the client himself who is too optimistic, and the reason for his optimism lies in the inexactness of the science of engineering.

It follows, therefore, that from such a condition certain difficulties arise. In the first place, the engineer is ignorant of what is below the surface of the earth, and his methods of test do not always give the needed information. Borings give only a meager idea of the rocks and soils, and they tell still less about the pressure which the soil may have on works or what foundation pressures may be regarded as safe. Experiments made with crushed samples are worthless, and even experience often proves an unsafe teacher. Secondly, the engineer must war with the elements. Unforeseen floods may wash away falsework, damage permanent work, or cause expensive delays, while rain, snow, hail and sudden changes of temperature may work havoc with well-conceived plans. His rivers do not behave as he thinks they should. In the third place, the materials with which the engineer must work are not uniform in character, and this lack of uniformity may vitally affect the

finished work. He may make computations to his heart's content, but he cannot tell from his results the *actual* stresses in a masonry dam, and must base his designs largely on experience. In the fourth place, the engineer cannot tell with certainty the course of future prices, or how the bidder will estimate them; he cannot tell what factors may influence the bidder, how strong is his desire to get the work, what force of men he must keep employed, what new equipment he must purchase. Yet all these uncertain matters must enter into the engineer's estimate. Obviously they create a considerable margin of uncertainty which the careful engineer fully appreciates, but upon which the client is willing to take a sporting chance.

To overcome the uncertainties due to lack of knowledge Sir Maurice emphasizes the desirability of research and the value of preliminary studies, and praises the spirit which has prompted the governments of Canada and the United States to accumulate facts relating to rainfall, stream flow and other matters. This opinion is of especial interest, as the question is often asked here whether preliminary experimental work has not been carried too far. That it may be carried too far is of course true, but in proportion as our knowledge increases the margin between high and low bids should shrink and benefits result to both client and contractor. Research, rightly conducted, will not only advance the arts of engineering and serve as a protection against gross failures, but it will conduce to better business arrangements between clients and contractors and enhance the professional standing of the engineer himself.

The address closes with an appeal to young engineers to take every opportunity of carrying out experimental work. "Such opportunities occur on nearly every undertaking. It need not be original work, but even the repetition of work previously done gets one interested and accustomed to that class of work and it may be the means of correcting and enlarging the work done by others." These words, coming from so great a master of engineering as Sir Maurice, should be heeded by the young engineers of America.

Armies Out of Work

NOW that all Europe, and indeed America as well, has reached nearly the required maximum of productiveness as far as war supplies are concerned, the industrial problems of the after-war period are coming up for the careful consideration they deserve. While class after class of men have been drafted for strictly military purposes, there has not only been no falling off in the volume of production but an increase of such magnitude that the absolute efficiency of society must have been nearly doubled to account for it. What social effect this will have when the armies are demobilized is giving no little concern to those in authority. Obviously it will not suffice to leave the solution to time and chance, for error here might involve the world to a degree which would endanger civilization itself.

But in the very process of the war will be found a

certain measure of relief. The London *Surveyor*, in its annual review number, calls attention to the forced neglect of public works. The cry for economy has led English highway authorities "to reduce their expenditures to such an extent as to jeopardize the very existence of the roads for which they are responsible," in spite of the fact that "war conditions have rendered it more necessary than ever to keep the home roads in a high state of efficiency." As regards bridges, "very few have been built during the year. Indeed, if we allow our survey to extend to the continent of Europe, the record is one of destruction rather than construction."

But here is found only a temporary relief, a definite task set for accomplishment. To repair war's destruction will utilize a certain limited number of men for a limited period, but will afford no new and continuous employment for soldiers whose jobs have been filled by women who will be loath to surrender their new wage independence, since they have fully measured up to the task imposed on them by economic, though patriotic, considerations. It must be realized that feminism will be an even livelier issue in the years of peace to come than ever before.

But, avoiding this last point, there is still the higher unit efficiency of production, and its effect upon available work, to be considered. A unit of value is being produced at half the former time expenditure, and this alone will give a critical tension to after-war conditions unless new fields are opened for development or additional farming lands are made accessible. The possibilities of colonizing the vast and fertile areas of Canada were treated editorially in the *Engineering Record* on Feb. 3, and no doubt here will be found a permanent and effective method of providing for many thousands of returned soldiers.

Perhaps the most promising of all is the project of greatly extending the network of permanent roads. This will not only stimulate peaceful industry near to the pitch of war-time necessity by making new consumers of cement, steel for bridges and road machines, and motor vehicles, but will make colonization more attractive by bringing it closer to centers of communal life. Every farmer is a consumer of manufactured products, perhaps even to a greater extent, individually, than his city-dwelling brother.

According to J. Duchastel, city engineer of Outremont, a suburb of Montreal, Canada has not only made provisions for new colonization schemes but has now on foot a movement to organize a vast road-building campaign upon which the men returning from European trenches will be used in large numbers. While it is well to appreciate the forethought of our neighbors, we of the United States must not overlook the fact that the new problems will not be confined to Europe and Canada. War's cessation will affect our industrial fabric as well, and unless we are prepared to meet the new conditions in as an efficient manner, trouble will be ours, and in large measures. We also will have a surplus of labor when the demand for war supplies ceases.

Would Redesign Times Square Station for New York's Enlarged Transit System

Proposed Plan, Recognizing Changed Conditions, Would Reverse Subway Levels at Intersection and Relieve Expected Congestion by Extensive Concourse

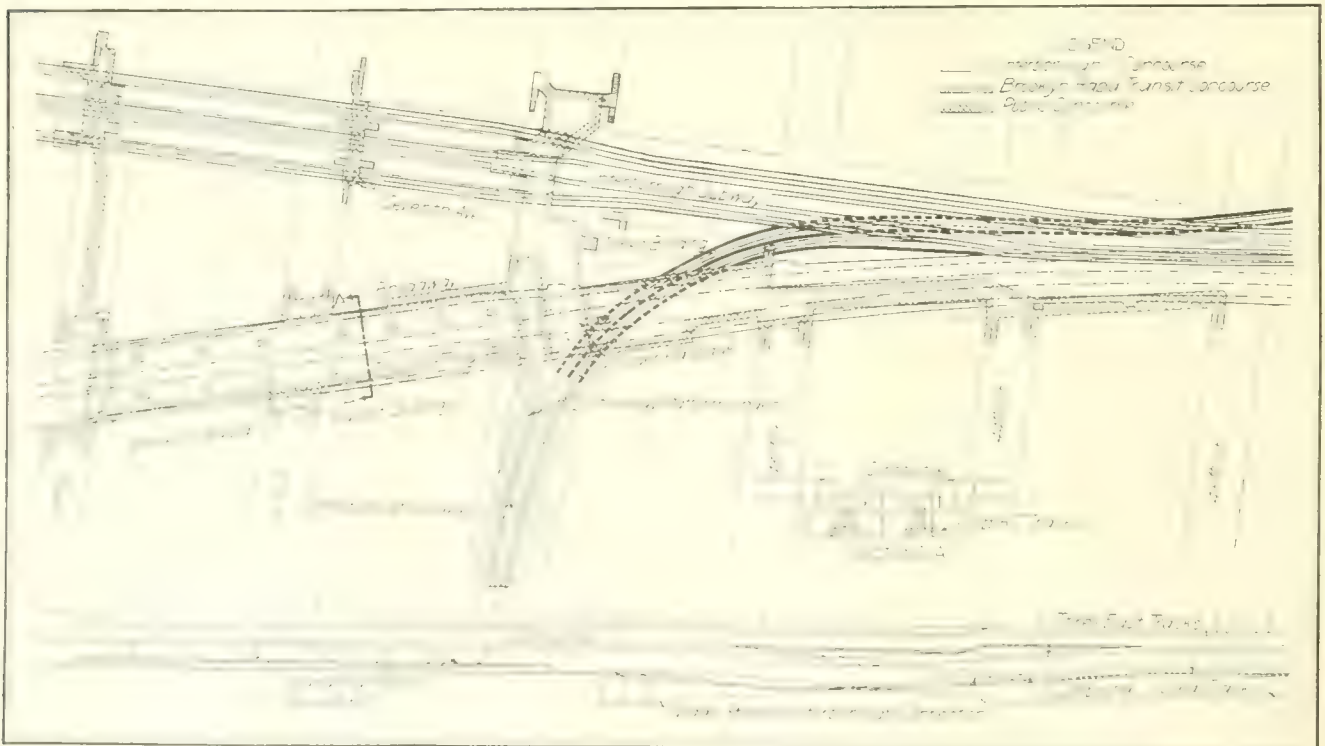
A RADICAL CHANGE in the Times Square station of New York's new dual transit system has been proposed by an association of interested business men. It involves a reversal of levels, at their intersection, of the Brooklyn Rapid Transit subway and the Interborough connection, if made, into Forty-second Street, and an extensive concourse under the streets to keep the patrons of the subways clear of the surface congestion. The project would not have been feasible under the conditions on which the adopted plan was predicated, one of which was the continued operation of the present subway until the opening of the Brooklyn Rapid Transit subway. Changes in other plans, however, make this impossible. Numerous advantages are claimed for the new plan, which is now before the Public Service Commission, and an important point is that in spite of the large amount of work already done at Times Square and the fact that much steel not yet in place has been ordered, the change can be effected with little waste of effort or material.

HEAVY TRAFFIC CONCENTRATED AT ONE SPOT

Times Square, New York City, midway between the two railway terminals of Manhattan and in the heart of the retail and theater district, is likely to become the most important focus of rapid transit in that city when the new dual system is put in operation. Here converge, in three connecting terminal or express stations,

the Broadway subway of the Brooklyn Rapid Transit lines and the Broadway-Seventh Avenue and Steinway subways of the Interborough lines. A description of the original design for these stations, though not wholly up to date because of subsequent revisions, appeared in the Engineering Record of Feb. 21, 1914, page 230. As now planned, the express station of the Brooklyn Rapid Transit line, located deep beneath Broadway in order to pass under the tracks of the present Interborough subway, is provided with exits only at the ends of its platforms. These exits are separated by 300 ft. Present experience indicates that the 22-ft. platforms will be gravely overcrowded from the start, and passengers to and from the district north of Forty-second Street will be obliged to cross at the surface the already congested intersection of Broadway and Forty-second Street, or pay an extra fare.

Moreover, the connection between the new east-side and west-side lines of the Interborough as planned is by means of turnouts at grade under Seventh Avenue, and could hardly be used safely for passenger-train operation. The structures involved were planned under the necessity of placing the Interborough and the Brooklyn Rapid Transit lines in operation simultaneously. However, the change, forced at the eleventh hour by the city, from a bridge to a tunnel crossing under the East River at Sixtieth Street will postpone through operation of the Broadway line to its northern termini in



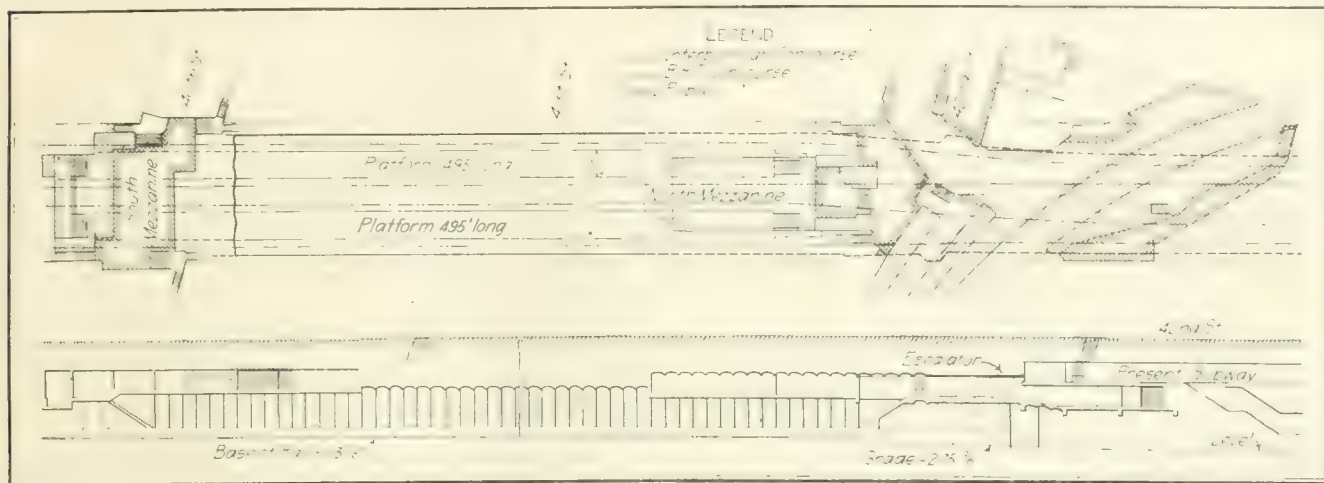
PROPOSED STATION LAYOUT WOULD DISTRIBUTE PASSENGERS UNDERGROUND OVER LARGE DISTRICT AND IMPROVE OPERATING FACILITIES

Queens two years beyond the possible opening of the Interborough lines. This delay gives rise to an opportunity to modify the original design, and such action has been proposed to the Public Service Commission by the Broadway Association. The changes suggested are designed, according to this association, to give the Interborough, if desired, an operating connection between its east and west lines, to relieve the threatened platform congestion in the Broadway station and to provide an underground mezzanine concourse enabling the passengers from any of the intersecting lines to reach their destinations on either side of Broadway or Forty-

gap cut in it by the two tracks which are to remain. It is planned, however, to leave the existing underpassage at Times Square to connect these two platforms.

BROOKLYN PASSENGERS CANNOT CROSS UNDER FORTY-SECOND STREET

As may be seen from the accompanying plan of the Broadway station as now being constructed, access to the trains is by means of island platforms 22 ft. wide, which connect at the south end by stairs and at the north end by stairs and escalators with small mezza-



STATION AS FIRST DESIGNED UNDER NECESSITY OF OPERATING EXISTING TIMES SQUARE STATION TILL LAST MOMENT PRESENTED MANY TRAFFIC DIFFICULTIES

second Street without crossing at the street surface. If made now, the change can be accomplished without sacrificing any of the material ordered for the construction under way. If built as originally planned, the physical limitations of the site would, it is thought, make the reconstruction of this station in the future impossible except at enormous expense.

ORIGINAL CONDITIONS NECESSITATED INADEQUATE DESIGN

With the intention contemplated in the dual system contracts of keeping the existing subway in operation until all the new lines were actually opened, it was found necessary to depress the Broadway tracks of the Brooklyn Rapid Transit Company to pass under the existing Interborough subway at Times Square, where it turns into Forty-second Street. Further headroom was lost in this design by reason of the necessity for a heavy roof on the new structure to carry the train loads from the old. It was further decided to connect the present northbound tracks from Forty-second Street to the new Interborough subway, and stub-end the present southbound tracks for the terminal of the Steinway line under Forty-second Street.

Although operating connections on the east end at Park Avenue to any pair of these Forty-second Street tracks are perfectly feasible, the present layout would make an operating connection at the west end impossible, because southbound trains from the upper Broadway line would have to cross two or more tracks at grade in order to reach Forty-second Street. The plan makes it impossible to convert the existing Times Square station into a large concourse because of the

nines. These exits are about 300 ft. apart. It is evident from the location of the controls shown on the plan that Brooklyn Rapid Transit passengers coming from or bound to points north of Forty-second Street would be obliged to cross that street at the surface or to pay the Interborough a fare for the privilege of entering or leaving the concourse under Forty-second Street from the north side.

Once built and backfilled, it would be impossible to provide additional exit facilities from this station either at Forty-first Street or through adjoining buildings without decking Broadway for a second time and removing this backfill. The street intersections at Times Square are already among the most congested and dangerous to pedestrians in the metropolitan district. With vehicular traffic on the increase, and with the great increase in foot travel brought to this point by the converging rapid-transit lines, this district, it is argued, would soon become, under the present plan, the scene of the most serious traffic problem ever presented to New York City.

CHANGES TO IMPROVE CONDITIONS

Now that it is apparent that the Brooklyn Rapid Transit Company cannot operate the Broadway line until after the Interborough is operating its new east and west subways, and there is an opportunity to remove the threatened congestion at Times Square, the Broadway Association has urged the Public Service Commission to take advantage of this fact and modify the present design so that no passengers from either of the three converging lines will be obliged to cross Forty-second Street or Broadway on the surface, so

that the Brooklyn Rapid Transit station will be brought nearer the street surface and the threatened platform congestion entirely relieved, and so that an operating connection, if found advisable, may be established from the Grand Central Terminal to the upper West Side.

This will be accomplished by raising the new Brooklyn Rapid Transit line till its roof forms the floor of the concourse under Forty-second Street; depressing the connection between Forty-second Street and the upper Broadway line, if this connection is insisted on, beneath this structure; using the existing center tracks under Forty-second Street for this connection and the existing outside tracks for the Steinway tunnel, and constructing a double-deck terminal in Forty-second Street east of Broadway; and extending the small concourse planned at present under Forty-second Street and Broadway south to Fortieth Street and north to Forty-fifth Street, using the roof of the new Brooklyn Rapid Transit subway as its floor. The general idea of keeping the two main subways at about the same elevation and passing the Forty-second Street Interborough connections under them, as well as that of an extensive subsurface concourse, has been presented before, notably in the so-called Harwood plan described in the 1914 article previously mentioned. The new plan, however, has various provisions not found in the Harwood plan.

TEMPORARY STREET SUPPORT UTILIZED TO ROOF CONCOURSE

The contractor for this section of the Brooklyn Rapid Transit line has employed a steel framework to support the street decking. This framework is at the approximate level proposed for the roof of the mezzanine concourse. As described in the Engineering Record of Dec. 23, 1916, page 760, it consists of a central longitudinal line of heavy girder beams into each side of which are framed I-beams at 10-ft. intervals. Supported by cast-iron columns and concrete sidewalks, this framework could be incorporated into a concrete roof which would support the far lighter backfill and the street loads, and which would conform to the specifications governing the design of the new subways. The ends of the transverse I-beams extend far enough to rest at the sides on the concrete walls of the concourse. In view of the present difficulty of obtaining deliveries on structural steelwork, the possibility of utilizing this steel already in place, and of avoiding the purchase of any considerable tonnage of new steel, is considered one of the strongest arguments in favor of the practicability of the proposed plan.

PROPOSED CONCOURSE AMPLE IN SIZE

The proposed concourse between the Interborough controls at the east side of Seventh Avenue and the east side of Broadway, and north of the Brooklyn Rapid Transit control at the south side of Forty-second Street would be open to the public. The existence of such a concourse, it is held, would solve the traffic difficulty at Broadway and Forty-second Street by providing an undercrossing for pedestrians in any direction.

Because it would be possible to provide a wide center platform between the stub tracks of the Steinway line over the depressed center tracks forming the connection between the Interborough lines, adequate platform facil-

ities for this terminal would be provided without the necessity for widening the present structure.

The platform congestion threatened under the present plan in the Brooklyn Rapid Transit express station would be relieved by placing narrow stairs from these platforms to the mezzanine floor at frequent intervals, so that no passenger would be obliged to walk more than a few feet after leaving a train before reaching a stair leading to a concourse so large as to obviate congestion.

From this concourse exits could be provided as traffic increased at every street corner and into any building along Broadway. Such connections have already proved valuable to real-estate owners whose property is located at stations of the existing subway, and it is held that there would be no difficulty in providing as many of them as would be desirable.

The raising of the Brooklyn Rapid Transit station level would result in an easy climb to the street, broken by a short walk at the mezzanine level. It would also do away with the necessity for escalators at the north end of the station. As long as such escalators existed there would be a tendency for a large percentage of the passengers to attempt to use them, resulting in serious congestion at the upper ends of the platforms. Moreover, being on a hump instead of in a depression, operation through the station would consume much less power in starting and stopping trains.

BOOTH RENTAL WOULD PAY FOR CHANGE

The total area of the concourse provided by this change would be approximately 35,000 sq. ft. Prevailing rents for basement space along this section of Broadway are already \$2 annually per square foot. Such property is far less valuable than booth space in a concourse of this character would be. The Broadway Association considers that \$4 to \$5 per square foot would not be too high an estimate for the revenue to be obtained from such a source. If 10,000 or 12,000 sq. ft. of the space so provided were thus utilized, the rental return capitalized would, it is estimated, cover the cost of making the changes proposed.

POSSIBLE EXTENSION TO WEST FORTY-SECOND STREET FERRIES

The headroom saved by raising the Brooklyn Rapid Transit tracks to a bare clearance under the floor of the concourse, in addition to that gained by the elimination of heavy girders to carry existing tracks in the Times Square station, would make the deepest point of the excavation for the connection between the existing Forty-second Street and upper Broadway lines, if built, only 8 ft. below the excavation required by the present plans for the Brooklyn Rapid Transit subway at this point. The north center track, which is the northbound express track of the existing subway, would pass beneath the Brooklyn Rapid Transit structure, come up between it and the existing subway and break to the left into the northbound local of that structure. The south center track, the southbound express track of the present subway, would pass beneath the Brooklyn Rapid Transit structure and beneath the Interborough structure, come up on the west side of that structure and break into its southbound local track in the neighborhood of Forty-fifth Street.

Under this plan the Steinway tracks, which have al-

ready been extended a considerable distance beyond Park Avenue under Forty-second Street, would be connected with the present pair of express tracks instead of with the present pair of southbound tracks. If it becomes desirable in the future to extend the Steinway tracks west to the Forty-second Street Hudson River ferries, a tunnel can be driven beneath the new Interborough subway on Seventh Avenue tangent to the center tracks forming the connection with the Interborough. Crossovers could be constructed in the Forty-second Street subway so that, if the physical connection were made, Interborough trains could take the center tracks.

COULD GIVE PARTIAL TRAIN SERVICE OVER PRESENT ROUTE

On the other hand, under this arrangement trains from the downtown East Side could be operated through to Times Square, thus making it unnecessary for the East Side line to operate half-empty trains during the rush hours above the Grand Central into The Bronx. This operating condition is considered likely to arise under the present plan because of the heavy commuting traffic entering and leaving the subway at the Grand Central Terminal. It is pointed out in this connection that the present subway has resulted in a residential distribution placing on the upper West Side many persons who wish to reach points on Park Avenue between the Grand Central Terminal and Fourteenth Street, and that under the present plans, until a considerable redistribution takes place, these passengers would be at a great disadvantage. Under this plan these passengers would transfer direct from expresses at Times Square to the locals bound for their destination.

CONSTRUCTION DIFFICULTIES NOT GREAT

The investigations of the Broadway Association show, it is stated, that the only important contract to be modified in carrying out the proposed change is that with the Holbrook, Cabot & Rollins Corporation for the construction of the section of the Brooklyn Rapid Transit subway extending from Thirty-eighth Street to Fifty-first Street, as no extensive modifications of the Interborough West Side subway are involved, and as contracts have not yet been awarded covering the Steinway terminal.

As regards changing the construction work on this contract, it is stated that all the steelwork for this section has been ordered except that for a short distance beneath the present Times Square station, the designs for which have not yet been approved by the engineers of the Public Service Commission. This one section, however, includes practically all the steelwork, the design of which would be greatly modified by the carrying out of the proposed change. The remaining steel in sections affected by the proposed change would be used as ordered, except that it would be set to the new grade line. Only a few bents of this steel have as yet been erected, and raising these to the new level would, it is said, involve little expense. It is stated that while the southbound track connecting with the Interborough, if this connection is decided on, would involve tunnel construction, the northbound track and all of the extra construction east of the Interborough structure could be carried on with ease and economy from the excava-

tion already made for the Brooklyn Rapid Transit subway. Very little of this latter cut is at present excavated below grade, as it was considered inadvisable to start excavation in the deep section beneath the present Times Square station in advance of the approval of the steel design.

The apparent difficulty of constructing exits into the buildings along Broadway below Forty-second Street on account of the ventilator wells at the sides of this station no longer exists. The scheme for ventilating this section of the subway has been modified, so that these wells are to be covered with vault lights, and employed to admit daylight to the station. They could be cut through at as many points as necessary without detriment to the ventilation of the station.

ACTION ON PROPOSAL EXPECTED SHORTLY

The progress of construction work on this section will soon have reached a point, it is stated, where considerable expense would be involved in making the change. Also, it is considered desirable to complete the station below Forty-second Street at an early date as a terminal for partial operation of the Brooklyn Rapid Transit subway. On account of these considerations, it is expected that the Public Service Commission will act on the proposal without delay. The committee of the Broadway Association which has had charge of presenting this change to the Public Service Commission consists of J. E. Harrington, chairman; Howard Brokaw, John G. Boggs, J. de M. Thompson and E. W. Estes.

Engineering Co-operative Methods Outlined

**Scheme to Be Presented by Subcommittee at Third
Annual Conference to Be Held in Chicago,
March 29 and 30**

IN ACCORDANCE with the resolutions adopted at the second Conference on Engineering Co-operation, a subcommittee, consisting of F. H. Newell, chairman, Hunter McDonald, Morris L. Cooke, C. E. Drayer and Isham Randolph, was empowered to prepare a plan for forwarding co-operation among engineering societies upon matters of general interest to the engineering profession, such plans to be presented for formal consideration at a third conference on engineering co-operation to be called by the subcommittee at such time and place as seemed to it desirable. The several organizations represented at this conference were to be presented with an estimate of probable expenditure which might be incurred by the subcommittee, and they were to be permitted to assist in defraying the expenses.

The following fundamentals were discussed and adopted for presentation at the third conference:

1. *National Societies*—As a preliminary to all efforts toward co-operation among existing engineering organizations there should be the expressed intent to assist in strengthening and unifying the work of the national engineering societies in the advancement of engineering knowledge and practice, and the maintenance of high professional standards.

2. *Local Organizations*—The invigorating of local societies is fundamental because of the fact that while

the great national societies are important in setting standards and in considering broad problems, yet local affairs make up at least nine-tenths of the vital problems of the engineer's life. In each locality where there may be a dozen or more engineers so situated as to be able to meet occasionally, there should be formed, if not already existing, an engineering association embracing all professional engineers, and others interested in engineering, to discuss and act upon these vital problems.

3. *Home Rule*—Each local engineering society should be autonomous or self-governed, wholly free in its activities from any dictation or control by other association or connections, fully adapted to local needs and conditions, and exemplifying in its activities the principle of complete home rule.

4. *Welfare of Members*—Each such local or self-governing unit in its organizations and activities should give full recognition to the fact that the majority of the membership necessarily consists of men not yet enjoying complete or independent professional status, but who in large part have had a college or technical training and who in time may become professional engineers in the full sense of the word. Because of this diverse character of members, the activities of the local society, while maintaining high professional standards, should be so planned as to meet the needs of the young men as well as the older and be directed toward the welfare of all classes of its members and, through them, of the public.

5. *Ethics*—Each local engineering society should adopt and frequently make application of a code of ethics prepared in accord with the standards established by the national organizations or approved by other professional bodies. It is recognized that while it is impossible to prevent all violation of such a code, yet eternal vigilance is the price of maintenance of high standards. The enforcement of such a code is essential to the well being of the community at large, as well as for the protection of professional men from the improper competition of unskilled or unscrupulous men tending to reduce the opportunity for effective service to individuals and to the public.

6. *Employment*—For the benefit of the great body of members, those who have not yet attained a standing which enables them to enjoy full professional status, there is needed the development of a scientifically planned and well conducted system of employment to be operated in co-operation by all engineering associations.

7. *Publicity*—Each independent association should maintain a local system of diffusing information on engineering subjects such as may be embraced in the term publicity, or of properly advertising the profession as a whole.

8. *Civic Affairs*—Each local society should devote time and thought to local civic, state and national affairs which influence engineering progress, and should take an active part in considering proposed new laws.

9. *Intermediate Societies*—With complete covering of the ground by vigorous local city and state associations, it is evident that there is no room for an intermediate engineering society such as the Engineering Association of the South, which has recently disbanded with the expectation that strong organizations will succeed it in each of the cities where it has been represented by

local sections. Such autonomous societies better fill the need of bringing engineers together in personal contact, arousing the spirit of fellowship and facilitating prompt action.

10. *The Public Engineer*—Each local society should give especial attention to the needs of those members who are in public employment, and should recognize the high ideals and performance of the public engineer, seeing to it that he is furnished sympathetic support in his efforts in the public service.

11. *Conferences*—An occasional conference of representatives from each engineering organization should be held at least annually, at which all matters such as those noted and others of general interest should be discussed. The expense of one delegate to such conference should be provided by each society.

12. *Field Secretary*—Provision should be made for maintaining a traveling secretary of the committee on co-operation who can visit each local body, give personal advice and assistance in ways which may aid in securing the highest efficiency and economy in administration, and who can address the membership on larger matters of concern to all engineers.

13. *Local Representative*—In each society efforts should be made to develop one or more of the younger members with especial reference to active participation in the co-operative movement, particularly to the diffusion of information on engineering in ways such as will catch and hold the public attention.

14. *Printed Matter*—An ample supply of printed matter should be provided for distribution, covering in particular the methods of organization of engineering societies, the maintenance of ethical standards, the ways of securing employment, and of diffusing information; also on other details which are of importance to officers and members of local societies and which will tend to stimulate interest and secure results in the business operations of the society.

Suitable standard blanks and letter forms should be made available for general use in obtaining information concerning employment and for correspondence with persons seeking work so that the necessary facts may be fully and quickly obtained.

15. *Finances*—In order to pay for typewriting, printing, postage and similar expenses, it is necessary to have a small fund at the disposal of the committee on engineering co-operation. At present it is not advisable to ask each of the various engineering organizations to contribute beyond the expense of sending delegates to the conference. In some localities, however, it appears that money may be raised by personal appeal instead of direct assessment, although it is hoped that each organization in time will contribute.

Good Roads Are Better Than Concrete Forts

Though modern artillery ranges are great, the precision of fire-control has been so developed that the heavy mobile howitzers make short work of permanent fortifications. Any system of defensive strategy, based on heavy guns permanently mounted, has been proved inadequate. With good roads the defensive army can adapt itself to the fluid conditions of modern war and, by rapid shifting of artillery, avoid the mistakes of the defenders of Liège.

Transformed-Section Analysis of Reinforced-Concrete Beams

Investigation of Given Sections by Direct Computation for Position of Neutral Axis, Moment of Inertia and Fiber Stresses

By J. H. CISEL

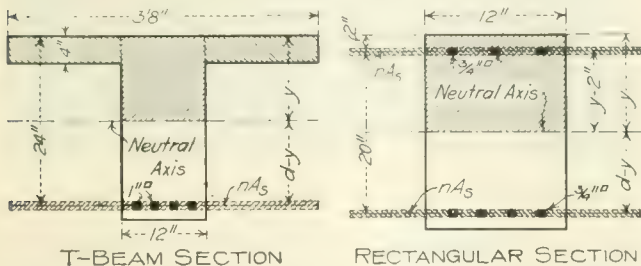
Instructor in Civil Engineering, University of Michigan, Ann Arbor, Mich.

LONG and cumbersome formulas for the analysis of LT-beams, beams reinforced for compression and other more complex sections can be avoided by a simple application of general methods of solution to the homogeneous transformed section. Such a general solution is here presented, based upon the standard notation, and using the homogeneous section easily obtained by multiplying the steel areas by n , the ratio of the moduli of elasticity of steel and concrete. Thus an equivalent concrete section is obtained, to which the ordinary principles of analysis for homogeneous beams are applied. An equivalent steel section could as well be used if desired.

[The article by W. S. Wolfe, on page 473 of this issue, gives the graphical solution of similar problems. It may be found that a combination of the two methods, in some cases, will be most effective.—EDITOR.]

GENERAL CASE OF TRANSFORMED SECTION

Adopting the usual fundamental assumptions for the analysis of reinforced-concrete beams, based upon the



NOTATION AND DIMENSIONS FOR ANALYSIS OF CONCRETE BEAMS

straight-line theory, it can easily be shown that an equivalent homogeneous concrete section will be obtained by multiplying the steel area by n . The neutral axis can then be located at the centroid, or center of gravity, of the transformed section. This is done most conveniently by equating the statical moment of the equivalent area on one side to the statical moment of that on the other side.

Knowing the position of the neutral axis, the moment of inertia of the transformed section with respect to this axis may be calculated, and the well-known fundamental formula $M = fI/y$ used to find the resisting moments for a given section, or the fiber stresses produced by a given bending moment.

The accompanying diagram gives the dimensions and notation used for the exact analysis of a reinforced-concrete T-beam, including the effect of the compression in the concrete of the stem above the neutral axis. To compute the safe resisting moment for this beam when $A_s = 4$ sq. in., $n = 15$, $f_s = 16,000$ and $f_c = 650$, the compressive area is divided, for convenience, into the parts shown in the figure. Equating the statical

moments with respect to the neutral axis of the transformed steel and the concrete,

$$(32 - 4)(y - 2) = \frac{12y^2}{2} - 60(24 - y)$$

Solving,

$$y = 7.31 \text{ and } d - y = 16.69$$

The moment of inertia about this axis can then be computed as follows:

$$nI_s = 15 \times 4 \times (16.69)^2 = 16,713$$

$$I_c = \left(44 \times 7.31 \times \frac{1}{3}\right) - \left(32 - 3.31 \times \frac{1}{3}\right) = 5,342$$

$$I = I_c + nI_s = 22,055$$

The resisting moments are therefore:

$$fI/y = M = \frac{650 \times 22,055}{7.31} = 1,960,000 \text{ lb.-in.}$$

$$f_s I / (d - y) = M = \frac{16,000 \times 22,055}{15 \times 16.69} = 1,410,000 \text{ lb.-in.}$$

The safe resisting moment is thus 1,410,000—given by the steel.

Given the rectangular beam shown in the diagram subjected to a positive bending moment of 760,000 in.-lb. with $n = 15$, $A_s = 2.25$ sq. in., and $A'_s = 1.69$ sq. in., to compute the fiber stresses in the steel and concrete, proceed as follows:

The transformed area of compressive

$$\text{steel} = 15 \times 1.69 = 25.4$$

The transformed area of tensile steel = $15 \times 2.25 = 33.8$

Equating statical moments of tensile and compressive areas about the neutral axis (using transformed section):

$$\frac{12y^2}{2} - 25.4(y - 2) = 33.8(22 - y)$$

Solving, $y = 7.58$ and $d - y = 14.42$

Then the moment of inertia will be:

$$nI'_s = 15 \times 1.69 \times (5.58)^2 = 789$$

$$nI_s = 15 \times 2.25 \times (14.42)^2 = 7018$$

$$I_c = 12 \times (7.58)^3 \times \frac{1}{3} = 1742$$

$$I = I_c + nI_s + nI'_s = 9549$$

Therefore the fiber stresses are:

$$f_c = \frac{My}{I} = \frac{760,000 \times 7.58}{9549} = 605$$

$$f'_s = \frac{nM(y - 2)}{I} = \frac{760,000 \times 5.58 \times 15}{9549} = 6680$$

$$f_s = \frac{nM(22 - y)}{I} = \frac{760,000 \times 14.42 \times 15}{9549} = 17,300$$

Correction of Formula for Locating Neutral Axis of Inclined Purlins

William Vetter, of Springfield, Ill., points out that the formula for $\tan \theta$ given in the second column of Mr. Fleming's article on page 347 of the issue of March 3 should read

$$\tan \theta = \frac{I_u}{I_r} \tan \alpha$$

In other words, the ratio of the moments of inertia was inverted in the original article.

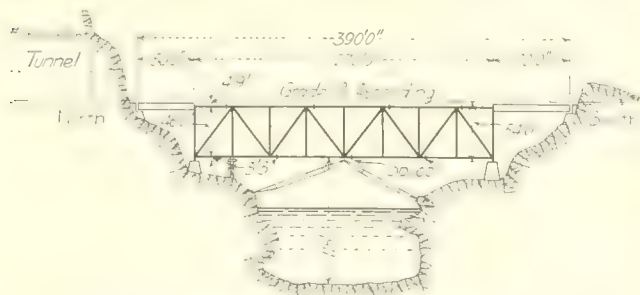


ERECTION OF 270-FOOT SPAN APPROACHING COMPLETION

Pool Point Bridge Erected by Using A-Frame Over Deep Water

Derrick Booms for Legs Fleeted Out Over Ravine and Brought to Bearing on Concrete Pedestals Placed on Rocky Side Walls

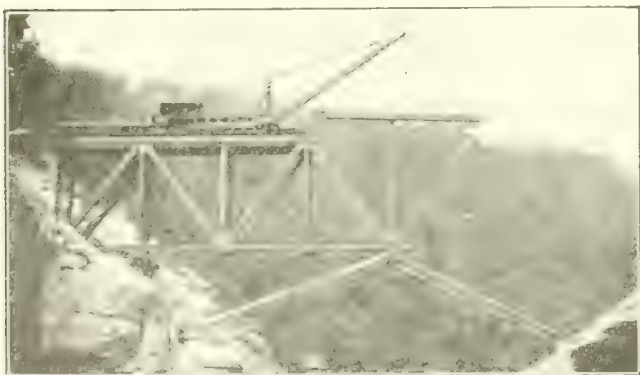
AN EXAMPLE of the solution of a difficult erection problem through taking advantage of the exceptional natural conditions is seen in the methods adopted in the case of the Pool Point Bridge on the Elkhorn extension of the Carolina, Clinchfield & Ohio Railway. This bridge crosses Russell Fork, a branch of the Big



CENTER SUPPORT WAS PROVIDED FOR CANTILEVER ERECTION

Sandy River, about 2 miles south of Elkhorn City., Ky., a short distance from the Virginia state line. At this point a deep basin, in which there is always from 50 to 90 ft. of water, has been formed in the rocky bed of the stream. This stream is of torrential character, and above the site of the bridge is a splash dam which at times discharges large numbers of logs which would carry out any ordinary falsework.

These special conditions made it impracticable to use

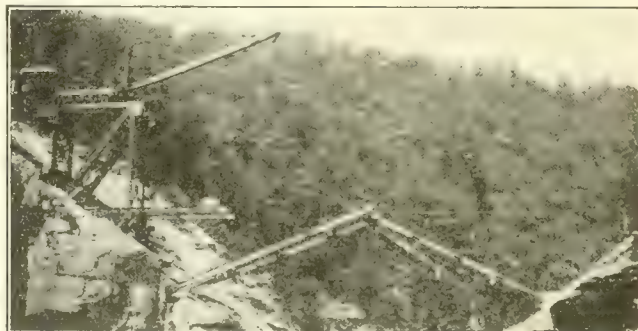


SWINGING CENTER TOP-CHORD SECTION INTO POSITION

falsework of the usual type. The character of the rocky side walls suggested the use of an A-frame or arch type of center support and cantilever erection from the north shore for the 270-ft. main truss span. This design was therefore made of the riveted type, with provision for compression in the lower chords and proper sections throughout for cantilever erection beyond the center-panel point. The A-frame legs, made of derrick booms, were fleeted out by derrick cars from the north end, where material was delivered through the tunnel, which is 634 ft. long and by which the railroad reaches the bridge.

The main truss span of nine 30-ft. panels, 270 ft. long, flanked on the north by a 50-ft. girder span and on the south by a 70-ft. girder span, as shown in the diagram, is composed of two trusses spaced 19 ft. apart on centers. The bridge is designed for Cooper's E-60 live loading, and the main span weighs 613 tons. The order of procedure in the erection of these main spans was as follows:

The end post and 50-ft. plate girder span having been erected by the derrick car at the mouth of the tunnel, the car could be advanced and the first panel placed with a temporary wooden bent at panel point L_1 , as shown. The car was then advanced and the A-frame legs, con-



A-FRAME LEGS OF 16 TONS EACH PLACED BY OUTHaulING

sisting of derrick booms with temporary trussing, were placed on the north side and held in position by guys. Following this, lines having been passed to the other bank, the south legs of the A-frame were swung or fleeted over.

The shore ends of the A-frame had cast-steel bolsters supported on concrete skewbacks and the tops were provided with cast-steel shoes for supporting the truss. The A-frame being in place, the remaining panels up to the center were erected, the splices being located as shown on the diagram, and the center panel point blocked up on top of the A-frame. From this point cantilever erection proceeded regularly panel by panel until the shoe at the south end had been placed.

The deflection of the cantilever end was about 8 in., and care had been taken to block the center high enough to bring the south end about a foot high, allowing for this deflection. Jacks were then applied and this south end lifted until the span was free at the center. The A-frame was removed and the span lowered to the masonry.

The steel work was designed, fabricated and erected late in 1913 by the American Bridge Company. Richard Khuen, Jr., was then division engineer; H. A. Greene, erecting manager, and L. H. Shoemaker, designing engineer.

Tests Indicate Drain-Tile Beddings Increase Strength

Careful Earth Bedding Raises Cracking Strength 25 Per Cent and Some Forms of Concrete Bedding 90 Per Cent

EXPERIMENTS on bedding drain tile in different ways, made at the Iowa Engineering Experiment Station, indicate that an increase in strength of 25 per cent may be obtained by careful earth bedding and as much as 90 per cent by certain forms of concrete bedding. W. J. Schick, drainage engineer for the station, gives the results, abstracted below, in a paper prepared for the recent convention of the American Concrete Pipe Association.

In general the tests consisted of bedding pipe in shallow trenches and then loading them through a standard upper sand bedding. The first series of tests were made with five 24-in. sewer pipe purchased at a reduced price from the Iowa Pipe & Tile Company of Des Moines. The second series of tests was made with five 24-in. drain tile donated by the Mason City Brick & Tile Company.

PIPE LAID IN SHALLOW TRENCHES

In each series of tests the pipe were laid in shallow trenches 6 in. wider than the outside diameter of the pipe, in soils essentially similar to some of those which may be encountered in construction work. The top soil in each case was a black loam and the subsoil a yellow clay. It so happened that the weather conditions at the time each series of pipe was laid were such that the ground was very dry and hard. For this reason, and more particularly to insure uniformity, the specified dimensions and shapes of trenches were adhered to more closely than would be the case in actual construction work. The work in other respects was no better than might be required of a careful contractor.

For beddings of Class 1, or "ordinary" earth bedding, the trench bottom was shaped accurately to fit the lower 90 deg. of the outside circumference of the pipe. The filling material, loose loam, was shoveled in without placing or tamping.

The results of tests of pipe in this type of bedding are only corroboration of the results of investigations of a large number of constructed drains and sewers. In no case were cracked pipe found in any drain or sewer, where the pipe were bedded in this way, when the strength of the pipe was one and one-half times the calculated load of the filling material.

TRENCH BOTTOM SHAPED

The second type of bedding investigated, termed Class 2, or "first class" earth bedding, was representative of the best practice in earth beddings in drain and sewer construction. The trench bottom was shaped to fit, approximately, the lower 90 deg. of the circumference of the pipe and then covered with about 1 in. of loose earth. The pipe was firmly bedded upon this layer of earth and loose loam tightly tamped in at the sides of the pipe, the filling in these tests being carried up above the midheight of the pipe. In this case, as in the beddings of Class 1, the work was more carefully and uniformly done than is common in construction work.

The tests of these pipe showed that this bedding increased the cracking strength of the pipe. From these results and those of examinations of constructed drains and sewers, it seems that pipe bedded in "first-class" earth beddings, such as are prescribed in the standard specifications of the American Society for Testing Materials, will have 25 per cent more supporting strength than similar pipe in the standard-strength test.

The third type of earth bedding tested was constructed by laying the pipe in a flat-bottomed trench and shoveling in the filling material without either placing or tamping. In reality such construction represents a lack of bedding rather than a type of bedding, but at that it is representative of some drainage construction. The tests of pipe so laid showed them to have less supporting strength than in the standard sand bedding strength tests or in Class 1 earth beddings. The tests so far made indicate that pipe so laid cannot safely be counted upon to support more than 85 to 90 per cent as much load as that in the standard-strength test.

SAND BEDDING OF DOUBTFUL VALUE

The first type of sand bedding tested was constructed by placing a 4-in. layer of fairly clean pit-run gravel or sand screened through a No. 4 screen in a flat-bottomed trench, wetting the sand and then placing the pipe upon it. Sand was then filled in at the sides up to a point above the midheight of the pipe. Just before the tests were made the sand was wet down so as to have all the sand in the bedding damp but not saturated. The sand was held even with the ends of the tile with boards held in place by stakes. It is possible that these boards allowed of some movement before the tile cracked, and observation during the tests showed that there was a very noticeable movement, at both top and ends, when the loading was continued after the tile had cracked.

During the past summer some tests of 18-in. sewer pipe in a special sand bedding were made in the laboratory. The work was done in connection with investigations of some sewer trouble, so that the bedding of the pipe reproduced, as nearly as possible, the conditions in this sewer. The pipe were bedded on about 5 in. of sand and then sand filled in around them up to one-fourth the diameter of the pipe above its midheight. The sand at the midheight of the pipe was about 13 in. thick. The pipe were bedded in a very rigid wooden box of the required dimensions and a plank bolted onto the top of the box at each side of the tile, parallel to it but not touching it. These planks prevented any upward movement of the dry sand when the pipe was loaded. The pipe were loaded through a standard upper sand box covering the whole length of the pipe.

PIPE BEDDED IN SAND HAVE GREATER SUPPORTING STRENGTH

Both of these tests indicated that pipe bedded in sand will have a supporting strength 25 to 30 per cent in excess of their average ordinary supporting strength, as given by standard-strength tests. The cost of securing sand in many places and its undesirability around drain tile, together with the fact that pipe in sand beddings have but very little more strength than pipe in "first-class" earth beddings, make this type of bedding of

doubtful value in all drainage work and in most sewer work.

Mr. Schlick was careful to state that the investigations of the supporting strength of pipe in concrete beddings have not been carried far enough to warrant any definite conclusions as to the value of the different types of bedding, but some brief descriptions of the beddings tested and general statements of the results so far obtained may be of value.

SOME QUESTIONS RAISED BY CONCRETE BEDDING

In making all types of concrete bedding described below, the trench was dug about 6 in. wider than the outside diameter of the body of the pipe. The pipe were bedded so that a space of about 6 in. was left between the ends of adjacent pipe, the concrete being held even with the ends of the tile by boards held in place by stakes.

These tests indicate clearly that there are some additional questions which must be considered in calculating the strength of a pipe bedded in concrete. It seems that the percentage of increase in supporting strength which any given type of bedding will cause for different types may vary inversely, though not necessarily proportionately, with the strength of the pipe. This is more noticeable in the case of beddings which have in themselves some resistance to side pressure, and is thought to be due to the fact that the actual strength of the bedding is the same for all kinds of pipe. The strength which the concrete in the bedding will develop by the time the pipe are loaded depends on the degree to which the concrete has been cured, and so depends upon the same conditions which control this factor for all other concrete structures. Because of these uncertainties and because the investigations have not been carried far enough to warrant definite conclusions regarding the value of the different types of concrete bedding, the percentages given here are only indicative.

CONCRETE BEDDINGS IN SOLID SOILS GIVE HIGH VALUES

A bedding constructed by placing the pipe on earth for 90 deg., as in Class 1, and filling the spaces at the sides with 1 to 8 concrete up to a height of one-fourth the nominal diameter of the pipe above its midheight, increased the supporting strength of the pipe 50 to 60 per cent.

A concrete bedding in which the trench bottom is shaped to fit, approximately, the lower 90 deg. of the pipe and 2 in. of concrete placed under the pipe, with concrete at the sides, as previously described, increased the strength of the pipe 60 to 70 per cent.

A bedding constructed by laying the pipe in a flat-bottomed trench and filling in at the sides of the pipe, up to the height of one-fourth the nominal diameter above the midheight with 1 to 8 concrete, increased the strength of the pipe 80 to 90 per cent.

YIELDING SOIL GIVES NO LATERAL SUPPORT

As it was impossible to reproduce the conditions in a trench dug in what is termed yielding soil, and to be sure that the conditions were the same for different pipe, a method more severe was used. When the concrete in beddings of this general type had taken its

initial set, the earth was dug away at the sides. This procedure is justified by the fact that it is very improbable that any soil termed yielding would give the bedded pipe any side support until after it had cracked and deformed.

The first type of concrete bedding for yielding soils was constructed by digging a flat-bottomed trench, placing 5 in. of 1 to 5 concrete in it, placing the pipe upon this layer of concrete and filling in with concrete at the sides up to the height mentioned for other types of bedding. After the concrete had set, the earth was dug away at the sides so that the concrete bedding received no side support. The few tests made indicated that such a bedding in a yielding soil will increase the strength of the pipe 40 to 50 per cent. The second type of concrete bedding for yielding soils was constructed by bedding the lower 90 deg. of the pipe upon earth, as in Class 1, and filling in at the sides with 1 to 8 concrete up to a height of one-fourth the diameter of the pipe above the midheight. When tested with the earth dug away outside, the concrete pipe in this bedding had less strength than pipe in the earth beddings of Class 2, "first class."

CONCRETE BEDDING GOOD IN ANY SOIL

The one bedding of this general type was patterned after a concrete bedding used by the Philadelphia Board of Public Works and will be of equal value in all soils firm enough to prevent vertical settlement. This bedding was constructed by placing a layer of concrete in a flat-bottomed trench, placing the pipe thereon and then filling in at the sides with 1 to 8 concrete up to a height of one-fourth the diameter of the pipe above the outside of the pipe at the bottom. In the tests with 24-in. sewer pipe the minimum depth of concrete under the pipe was made 5 in. When these pipe were tested none of the beddings were cracked, indicating that the beddings were stronger than the pipe required. When the 24-in. drain tile were bedded in this type of bedding the thickness of the layer of concrete in the bottom was reduced to 3 in. After these pipe were tested, very fine cracks were found in the bottom of three of the five beddings. None of these cracks were visible until after the tile had collapsed, so that it is possible that they may have been caused by the fall of the upper segments of the tile and the upper sand box and blocking. Such a bedding increased the strength of the pipe 60 to 70 per cent.

Considerable caution should be used in applying the results of tests of pipe in concrete beddings, Mr. Slick stated, because these values depend only on tests of ten pipe of two kinds and all of one size.

Cheap Power Attracts Nitrogen Plant to Washington

A nitrogen plant is being erected at La Grande, Wash., near the Tacoma municipal power plant, from which source power was contracted for at a rate of 1.15 mills per kilowatt-hour. The power sold is surplus which the plant does not require at present and the municipality retains the privilege of discontinuing service at any time. The American Nitrogen Products Company is erecting the plant, which is reported to involve a \$500,000 investment.

Traction Is a Straight-Line Function of Tire Width

Experiments Show That Resistance Is Decreased 30 Per Cent by Increasing Width of Tires from 1½ Inches to 5 Inches

IT has been recognized for many years that the narrow steel tire is enormously destructive to earth and gravel roads. The formation of a rut begins practically with the passage of the first vehicle improperly equipped, and though the users of such roads were aware of this fact and of its effect upon the usability of the highway, they were slow to adopt the wider and seemingly clumsier equipment. The U. S. Department of Agriculture in Bulletin 72, from which the following has been abstracted, shows that the effort necessary to draw a certain load is an inverse function of the tire

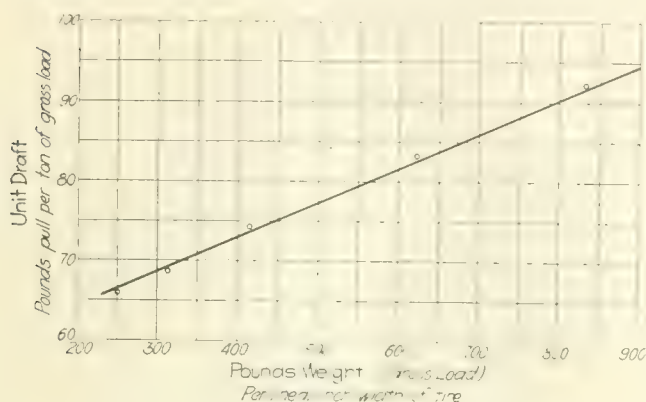
beyond a certain point, but there may be a positive disadvantage in so doing.

NEW WAGON CLASSIFICATION SUGGESTED

The present method of designating wagons by the diameter of the skein is thought to be clumsy, and, as a substitute, the following is proposed:

Class	Load	Tire width
1-horse wagon	1,000	2
Light 2-horse wagon	2,000	3
Medium 2-horse wagon	3,000	4
Standard 2-horse wagon	4,000	4
Heavy 2-horse wagon	5,000	5

The information as to carrying capacity should be stenciled on the rear axle. There are no definite recommendations that these limitations be incorporated in State legislation, but the inference is obvious.



GRAPH SHOWS UNIFORMITY OF TEST CONDITIONS

width, and in this manner forwards another argument against excessive load concentrations on the road surface.

The final recommendations of the department are based, further, upon the weight per inch of width of the more common type of roller, it being felt that no load exceeding that at which the road was compacted should come upon it. An examination of many road rollers shows that the most frequently used weight is between 500 and 550 lb. per inch of width. The reasoning on this point is so elemental that it seems almost unnecessary to do more than call attention to the fact, yet the common type of farmer's wagon has tires so narrow that these rational figures are generally exceeded when the vehicle is loaded.

TESTS MADE UNDER CONTROLLED CONDITIONS

The accompanying curve is plotted from data obtained under similar conditions of moisture and atmosphere. The earth road was plowed, graded and rolled between each series of tests, and its condition throughout the investigation was probably as uniform as the nature of the test warranted. A gross wagon load of 5000 lb. was maintained, the tire width being varied from 1½ in. to 6 in.

The unit draft decreases directly as the weight per inch width of tire decreases, until a weight of 250 lb. per inch of tire is reached, as is indicated by the curve. The draft for a 6-in. tire is larger than that for a 5-in. tire. This was uniformly true, and indicates that there is not only nothing gained by increasing the width

Revolving Screens to Be Installed for New York Sewage

No Nuisance Is Expected from First Manhattan Island Unit of Sewage-Disposal Plan—Additional Plants to Be Built Later

A SEWAGE-SCREENING plant comprising two 14-ft. Reinsch-Wurl screens will be built in New York City this spring. The works will be the first ever constructed for the treatment of sewage on Manhattan Island. This plant is the forerunner of others that are to serve not only all of Manhattan but the other boroughs of Greater New York as well, although a small part of the sewage of two other boroughs is already being treated. Designed to screen 10,000,000 gal. per day during stormy weather and 5,000,000 gal. during dry-weather flow, the plant will treat the sewage that comes from only a small section of the borough, and which is at present being discharged without treatment into the Hudson River through the Dyckman Street outfall. According to Charles E. Gregory, engineer in charge, of sewers, Borough of Manhattan, provision has been made for a future extension of the Dyckman Street system to provide for increased population in the tributary area.

WHY SCREENS WERE CHOSEN

Important factors in the selection of the type of plant were their small size and freedom from nuisance, as influenced by the high land values in New York, and by the close proximity of residential surroundings and a ferry terminal. An estimated ultimate dilution of 50 to 1 was considered ample to digest the impurities remaining in the effluent, provided sufficient solids were removed so as to prevent the accumulation of sludge banks. The dilution will be greater, due to the comparatively small quantity of sewage that will at first be treated at each of the many plants to be built at different points along the shore. It is planned to construct these other plants in the near future, although much will depend on the success of the Dyckman Street plant.

SERVICEABLENESS OF SCREENS

An investigation showed that the Reinsch-Wurl screens not only would require less space than any other

system of sewage disposal but would provide freedom from nuisance as well, and therefore would prove the most satisfactory in meeting local conditions. The somewhat disappointing result in per cent of solids removed reported from the experimental revolving screen installed at Cleveland, according to Mr. Gregory, was due to the high inflow head and the resultant swirling motion when the sewage passed onto the screens, thus causing clogging. In the New York screens the inflow head will be only from 3 to 6 in. The fresh condition in which the sewage will enter the plant also favors satisfactory operation, as the solids will not have become broken up and disintegrated by a long flow. A fact noted during the investigation was that the visible removal of a quantity of solids indicated the serviceableness of the screens, although a high percentage of removal of the finely divided particles was not expected. Experience in Dresden, Germany, covering several years, indicated the removal of a large percentage of suspended solids, but in New York it is expected that only from 20 to 30 per cent of the suspended solids will surely be removed, and that this will be sufficient to prevent formation of sludge banks, thereby relieving the condition in the vicinity of the present outfall where accumulations now exist.

NUISANCE TO BE AVOIDED

In order to make the plant as unobjectionable as possible, it will be washed down so as to prevent putrefaction, and the screens will be cleaned with washing soda and hot water. At first the screen accumulations are to be carried to sea by barges, but it is hoped that a process may be found whereby grease and other by-products may be extracted from the screenings in paying quantities. Another plan is to send the screenings to garbage-disposal works.

The chief desire is to construct a plant which will prove as unobjectionable as possible to the community, and so the design as a whole has been made to conform with the proposed wide maritime way that is to extend to the future bulkhead line, while the building itself is of a type in harmony with the residential surroundings. The work is under the supervision of Borough President Marcus M. Marks.

With Simple Device Exact Wear of Concrete Pavements Is Measured

Copper Plug in Drill Hole Serves as Datum Upon Which End of Scale With Conical Base Rests

By A. N. JOHNSON

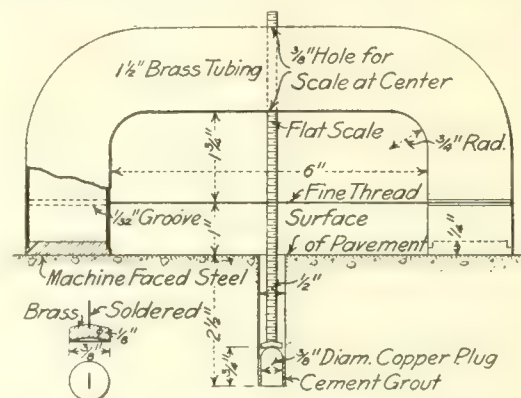
Consulting Highway Engineer, Portland Cement Association, Chicago

WITH the use of rigid types of pavements or pavements which rest upon a rigid base, the methods that had been devised for measuring the wear of macadam roads are open to considerable error, aside from usually being rather clumsy. Most of these devices provided for reference points at the sides. But where the pavement consists of a rigid slab or rests upon one, the observations that will be secured from a straight edge or wire stretched across the road are often quite

useless, due to the movement of the slab and the possibility of its fracture because of unequal settlement. The method here proposed will overcome such difficulty and is also extremely simple and convenient.

COPPER PLUG IN DRILL HOLE

A drill hole $\frac{1}{2}$ in. in diameter is made in the pavement. In the case of a concrete pavement it may be 2 or $2\frac{1}{2}$ in. in depth. In the bottom of the drill hole is set a copper plug about $\frac{3}{4}$ in. long, with its top made semi-spherical. The plug is embedded in the hole with cement paste. A short steel scale divided into inches and hundreds, small enough to be placed in the drill hole, is provided. At its end is a small button with conical undersurface, which is to rest on the spherical end of the copper plug. Across the surface of the pavement bisecting the drill hole is stretched a fine thread, and measurements are made with the scale. The hole is then filled with a wood plug, left flush with the surface,



WITH THIS DEVICE WEAR OF CONCRETE CAN BE EASILY AND ACCURATELY MEASURED

which is to be removed when subsequent readings are to be made.

A better, and probably more convenient, method would be to have a U-shaped handle, which will span about 6 in., having flat ends on the legs. Drawn between the supports is a tightly stretched thin thread or wire 1 in. from the surface of the pavement. This is to be held so that the thread will be over the center of the drill hole. The flat ends of the legs rest on the pavement surface and the measurements are made to the thread. The fact that the thread is raised above the pavement will make it possible to read the scale more conveniently, and is an easy method of holding the thread. The bridge or U-shaped handle holding the thread may first be placed longitudinally with respect to the pavement, then transversely, and in as many other positions as desired. The average of all readings is taken. The handle may be made of hard wood with metal-shod legs or of a bent hollow brass tube about $1\frac{1}{2}$ in. in diameter.

This simple method will give, it is evident, data from which the exact wear at any point of the pavement is desired. A line of drill holes, spaced about 15 in. apart, at various places in the pavement, would give sufficient data to determine the variation in the wear at different points. In the case of concrete pavements these data would be of special value to determine what influence variations in the materials of the concrete had upon the wear. The accompanying sketch illustrates the apparatus.

Opinions on Catchbasin Cleaning Methods Differ

But Symposium of Sanitary Engineers Held in Boston Accents Value of Cleaning Rigs Mounted on Motor Trucks

TESTS with a catchbasin cleaning truck led George A. Carpenter, city engineer of Pawtucket, R. I., to announce a cost of 75 cents per cubic yard, based on an average load of 2.6 cu. yd. and a haul of $1\frac{1}{4}$ miles. He states that the outfit developed by him cleans the basins in a practical and rapid manner and at a cost much less than by manual methods. These facts were brought out in a symposium on "Catchbasin Construction and Maintenance," recently held before the sanitary section of the Boston Society of Civil Engineers, from which the following matter has been condensed.

The truck used by Mr. Carpenter was of 32 hp. and carried a steel body $9 \times 4\frac{1}{2} \times 2\frac{1}{2}$ ft., having a capacity of 3.4 cu. yd. Cover plates 2 ft. wide are placed over each end to prevent slopping. The loads have averaged 2.6 cu. yd., or about 3.4 tons. In the rear of the driver's seat is a 2 hp. gasoline engine which drives a cable running through an outrigger to an orange-peel bucket. The engine at present in use is insufficiently powered and will be replaced by one of 4 hp. Though oil has been used in the operation of the loading device, tests with compressed air have proved it very satisfactory, and it will be used in the future. The average loading time was 7 min. per cubic yard, and the speed to the dump a little over 7 miles per hour.

TRUCK'S MOTOR USED TO RAISE BODY

New York City has been using a somewhat similar outfit. Though based on Mr. Carpenter's design, the unique feature of the truck described by Charles E. Gregory, engineer-in-charge of sewers, Borough of Manhattan, is the use of the truck's motor in place of a special gasoline engine. The body has a capacity of $5\frac{3}{4}$ yd. and is filled by an orange-peel bucket 20 in. in diameter. This bucket is to be replaced by a heavier one, as difficulty has been experienced with it when hard material was encountered. The outfit is practical and a saving in maintenance has been realized.

The Otterson Auto-Eductor was described by Philip W. Taylor, who said that it had been used successfully in the West, cleaning the basins very easily and economically. Edgar S. Dorr, office engineer of the sewer-service department, Boston, Mass., stated, however, that the Otterson had proved unsuccessful at both Boston and Cambridge. John H. Gregory, of Hering & Gregory, New York, stated that his views were fully expressed in an article on "Hydraulic Ejectors for Grit Removal Merit Trial in Sewer Maintenance," published in the Engineering Record of Jan. 29, 1916.

INLET DESIGNS PROVE INTERESTING

According to L. M. Hastings, city engineer of Cambridge, Mass., one great disadvantage of any inlet grate is the likelihood of its clogging during a storm, which he states as the reason for having the throat in the curbstone. Where a basin is located in an unfavorable position, he has successfully tried the expedient of placing another grate about 10 ft. away with a connection to the regular basin.

In order to stop water flowing past gratings in hilly districts, Gordon H. Fernald, assistant engineer of the sewage-disposal commission, Fitchburg, Mass., has designed a grate having bars running obliquely to the line of the gutter, the back corner of each bar being $\frac{1}{4}$ in. lower than the front. The velocity of the water is diminished thereby and the flow diverted toward the gutter mouth.

FLANGED AND BOLTED TRAP SIMPLIFIES CLEANING

To let water off when the basin is plugged, it is only necessary to raise the flap on an outlet trap described by Mr. Dorr. The trap itself is detachable, the castings being flanged and bolted. Another trap design presented by William A. Brown, assistant engineer of the highway department, Providence, R. I., shows an iron basin placed beneath the invert of the outlet pipe. The sides rise to such a height that an iron hood, extending within the basin to a point below the invert of the pipe, forms a seal. Frank A. Marston, designing engineer for Metcalf & Eddy, Boston, comments on this design, stating that it is put out of service automatically when the sediment fills the trap. He adds, however, that the shape of the catchbasin permits water standing above the sediment to be bailed into the trap by the "bottom man," obviating the necessity of hoisting the water to the street surface.

A catchbasin designed to permit the water to seep away was shown by Mr. Carpenter. By using porous brick for the inner ring, water seeps through to a 2-in. collecting space between the two rings of brick and is carried away by a 4-in. drain leading to the sewer.

To lessen the trouble caused by street cleaners filling basins with refuse, Mr. Dorr described a catchbasin with a side inlet and having no opening over the catchbasin itself. The inlet is so arranged that not more than one or two bushels of refuse could be packed into the opening. In this connection Mr. Marston remarked that if the work of the various departments having in charge the design, construction and maintenance of basins could be under the general supervision of one official, much better conditions would prevail.

RÉSUMÉ SHOWS VALUE OF SYMPOSIUM

Mr. Marston epitomized the discussion as follows:

1. Where combined sewers or drains are laid on very flat grades, not providing self-cleaning velocities, catchbasins are useful to retain refuse in order that it may be removed more economically than from the sewers or drains.

2. A considerable saving in the cost of cleaning catchbasins can be effected by the use of a suitable motor-truck equipment.

3. Of the two examples of motor-truck apparatus described that developed by Mr. Carpenter appears to meet the conditions in New England cities where the Otterson machine, though successful in the West, has failed.

4. Where self-cleansing velocities can be obtained, inlets without traps should be built in preference to catchbasins, both for reasons of economy and better service. Furthermore, it may be more economical to construct a single catchbasin in the main drain at the head of a section laid on a very flat grade than to build catchbasins for a large number of surface connections.

5. Oil should be applied to the water in catchbasins to prevent the breeding of mosquitoes.

6. Catchbasins should be regularly inspected and, if necessary, should be cleaned after every severe storm.

7. Catchbasins should be built only where special conditions make them necessary, and not as a matter of routine, as appears to be the practice in some cities.

8. Unless catchbasins are actually catching grit, which would otherwise be deposited in the sewer or drain, they should be replaced by inlets.

Rods Hold Settling Concrete Road Together

With Ordinary Maintenance of Cracks, Pavement Is Not Seriously Impaired, Although Profile Presents a Series of Vertical Curves

By H. B. BUSHNELL

Division Engineer, Illinois State Highway Department

TWELFTH STREET in Cook County, Illinois, east of Hillside, presents a striking example of the settlement of a rigid pavement laid on a yielding subgrade. At this point the road extends through a slough for 600 ft., and though the maximum settlement at the time the last levels were taken was 1.74 ft. it is still in good condition. While a considerable number of small transverse cracks have developed, no longitudinal or diagonal cracks have appeared. The longitudinal reinforcement has kept the cracks from becoming large, and if these are given ordinary maintenance the utility of the road will not be seriously impaired.

OLD ROAD WAS OFTEN COVERED WITH WATER

Before the new construction was built with state aid, the slough was crossed by a 20-ft. waterbound macadam highway underlaid with corduroy. During the entire year the slough was covered with an average depth of water of from 2½ to 3 ft., which during periods of heavy rain rose sufficiently to overflow the old highway. Except at very great expense and considerable litigation, it seems impossible to effect perfect drainage.

Before the concrete road was laid, a large ditch, approximately a mile in length, was dug along the Illinois Central Railroad's right-of-way, effecting a reasonably good drainage into a small creek near by. The grade of the old road was raised about 2 ft. and a large culvert constructed under the road to carry off flood water and to equalize water depths on both sides of the road. This provided a large storage capacity which held the excess water until the level of the creek fell sufficiently to drain the slough. This has proved satisfactory, the slough being practically dry about nine months of the year.

The new grade was built up from strippings taken from a nearby stone quarry, the work being completed

late in the season of 1914. Though the subgrade was thoroughly rolled and every effort made to compact the fill, it was impossible to secure a foundation that would not wave in front of the roller.

In July, 1915, an 18-ft. concrete pavement, especially designed for the conditions, was constructed across this section. The specifications called for a slab 10 in. thick at the center, 8 in. thick at the edges and reinforced with ½-in. square bars, 12 in. on centers in both directions, located mid-depth of the slab. All concrete was to be 1:2:3½.

Each day's work was squared up by a wooden bulkhead through which the reinforcing steel extended to furnish a definite bond with the next day's work. Since no so-called expansion joints were provided the entire length formed one continuous slab.

SETTLEMENT EXPECTED AND STUDIED

It was expected that the pavement would settle, and preparations were made to take level readings at definite times during construction and subsequently. Permanent benchmarks were placed near the ends of the



LARGE DITCH DRAINS SLOUGH NINE MONTHS OF YEAR

road and stations marked on the concrete at every 100 ft. Levels were taken at each edge and at the center.

The accompanying table shows the settlements that have occurred. The sides settled practically the same as the center, and there was no appreciable settlement east of Section 155. The last station given is at the west end of the road.

Portland Cement Shipments Break Record

Shipments of Portland cement in the United States in 1916 approximated 94,508,000 bbl.—an increase over 1915 of more than 7,500,000 bbl., and the heaviest shipments in the history of the industry. Production, while it did not keep pace with shipments, reached a total of about 91,194,000 bbl., which is an increase of more than 5,000,000 bbl. over 1915. Stocks fell off more than 3,000,000 bbl., according to estimates by Ernest F. Burchard of the U. S. Geological Survey. Prices averaged higher and trade conditions were generally better than in 1915.

Settlements of Concrete Road			
	April 1, 1916 (before road)	March 9, 1916 after 8 months	Nov. 1, 1916 after 16 months
156.....	0.00	0.00	+0.01
157.....	0.24	0.58	0.90
158.....	0.32	0.73	1.09
159.....	0.37	0.79	1.11
160.....	0.60	1.29	1.74
161.....	0.49	1.14	1.56
161+38.....	0.08	0.49	0.81

A. R. E. A. Committees Complete Another Year of Work

Abstracts of Reports Made to the Eighteenth Annual Convention of the Association, Which Was Held in Chicago This Week

[FOLLOWING OUR CUSTOM, we here present a summary of the reports made by its committees to the American Railway Engineering Association, in convention in Chicago this week. These reports have been appearing in the association's bulletins during recent months. Comment is necessarily brief. Since this summary is prepared in advance of the convention it of course takes no account of action on the respective reports. —EDITOR.]

Roadway

CONCLUSIONS recommended by the Committee on Roadway for adoption in the *Manual* have to do with width of berm under Class A track, with the desirable slopes for deep rock cuts and with the treatment of shrinkage in grading. The committee would retain its present standard berm for a depth of ballast of 12 in. or less below the ties, but would add to it for increased depth. Slopes of $\frac{1}{4}:1$ are recommended for rock cuts 40 ft. or more in height, the advantageous use of the cement gun for reinforcing bad rock on such slopes being pointed out. The committee thinks that little or no allowance in the height of a fill should be made to take care of shrinkage, unless the shrinkage of the material is well known in the conditions under which the fill is made. It recommends, however, an additional width of shoulder of from 10 to $22\frac{1}{2}$ per cent of the height, according to the anticipated shrinkage.

The findings of the committee with reference to shrinkage are based largely on an extensive investigation made by a subcommittee. In the 30-page report of this subcommittee mechanical shovels, locomotive cranes and dragline excavators are considered, as well as shovel methods and operations and blank forms.

Another subcommittee presents a seven-page report on the relative advantages and disadvantages of elevation or depression of tracks or streets, as the case may be, in the elimination of grade crossings. While no recommendations for the *Manual* are made, the subcommittee favors track elevation in industrial districts and depression in residential districts, where there are too many crossings to permit the tracks to remain undisturbed. The subcommittee points out the value of traffic counts in the case of numerous streets, with the view to vacating certain of the crossings and constructing lateral streets in their stead.

No conclusions are reached as to the allowable unit pressures on roadbeds of different materials, or as to the prevention and cure of water pockets in roadbed, although in connection with the latter subject a subcommittee made inspection trips over parts of two railroads. (Bulletin 194.)

Ballast

Following further investigation of the relative values of ballast, the Committee on Ballast presents a slightly different order of effectiveness from that referred back to the committee at last year's convention. Broken slag (not granulated) is relegated to third place, a distinction being made between washed gravel, which is placed second, and pit-run gravel, which is placed fourth. Stone remains first and chatts, burnt clay or gumbo and cinders follow pit-run gravel. The committee recommends adding a "weathering test" to the approved test of stone for ballast, and will make further inquiry into this subject this year.

The committee presents outlines of the organization of various ballast gangs, and sees special merit in the New York Central method of raising track on stone ballast. No conclusions are reached as to mechanical tampers and other machinery, or as to ballasting by contract.

Another year's study has practically confirmed the conclusions of the committee relative to ballast sections, and the recommendation is renewed for the standard ballast section for Class A track with sub- and top-ballast. Before making more definite recommendations as to the absolute depth of ballast, however, or the proper ratio between depth of ballast and spacing of ties, the commission desires to await further tests to be made. (Bulletin 193.)

Ties

Study by the Committee on Ties of the effect of design of tieplates and track spikes on the durability of crossties included an inspection by a subcommittee of the abandoned line of the Delaware, Lackawanna & Western Railroad between Clark's Summit and Hallstead, Pa., and also examination of answers to questions submitted to a number of railroads. Five conclusions on the subject of tieplates are presented as information, the first being that the principal cause of failure to protect the tie has been insufficient area and thickness of the tieplate. The committee thinks it has not yet sufficient data to present conclusions as to the effect of fastenings on the life of ties, but is convinced that the use of cut spikes driven without boring holes not only hastens decay, but also seriously impairs the strength of the tie, and that a properly designed screw spike is the least destructive of any present form of fastening.

Two additional sentences are recommended for addition to the *Manual* specifications for crossties. They have to do with restrictions on inferior timber, in localities where ties deteriorate very rapidly.

The usual report on metal, composite and concrete ties contains 17 pages this year. (Bulletin 193.)

Rail

Only one recommendation for the *Manual* is made by the Committee on Rail. This covers a revision of one paragraph of the specifications for quenched carbon and quenched alloy-steel joint cars. The nearly 500 pages of the committee's report, including 9 appendices, testify, however, to the usual activity of the committee.

Included in the appendices are the usual statistics of rail failures for the year ended Oct. 31, 1915. The inferences drawn are similar to those of last year, that the number of failures of rails rolled in successive years since 1908 has decreased, and that the failures of Bessemer rails are far more numerous than those of open-hearth.

The other appendices include a discussion by George F. Comstock on segregated streaks in steel rails; by H. B. MacFarland on a test of rail joints; by Dr. P. H. Dudley on induced interior transverse fissures; by W. C. Cushing on an improvement in the method of casting ingots and on the quick-bend test as a substitute for the drop test; and by M. H. Wickhorst on transverse fissure, rail 51,051, on transverse fissure rails on the Louisville & Nashville Railroad, and on the rail-failure situation.

The committee at large also reports progress on its investigation of track bolts and nutlocks, of details of manufacture and mill practice of rails, of joint bars and of other subjects assigned to it. (Bulletins 188 and 195.)

Track

Twelve subjects were assigned for the year's work to the Committee on Track. The committee offers for adoption in the *Manual* designs for cut spikes, screw spikes and screw spike testing gages, a definition of main track and a slight revision in the *Manual*. It offers as information seven pages relative to the design of and specifications for manganese frogs and crossings, together with drawings illustrating them.

Progress is reported in the study of the economics of track labor and the committee presents conclusions it has reached as to the best manner of continuing the work. Progress is also reported on the test of tie-plates subject to brine drippings. In the matter of reducing the present allowable limit for flat spots on freight-car wheels, the committee states that it has been in touch with the president of the Master Car Builders' Association, who advised that the executive committee of that association is opposed to such a reduction. The committee, however, thinks the reduction as a reasonable proposition, would not involve considerable expense and should be given more consideration. As to the limit of wear on the railhead and curve, the committee thinks no rule can be given and each road must decide the question. As to the extent to which the committee's frog and switch designs are being used by the railways, the committee has found that many roads are using them on new work, but thinks it is not practical to make frequent changes in previously adopted standards for general maintenance work.

Progress only is reported as to specifications for relayer rail for various purposes, and more time is

sought to report on typical plans of turnouts, cross-overs, slip switches and double crossovers and prepare detailed plans for such work, and also to report on reduction of taper of tread of wheel to 1 in 38 and on canting the rail inward. The committee believes it should be relieved, however, of further consideration of the effect of increasing the thickness of wheel flanges, as the wheel committee of the Master Car Builders' Association has concluded that this would accomplish nothing. (Bulletin 193.)

Buildings

The Committee on Buildings concentrated its efforts during the last year on the two subjects of ashpits and freight-house scales. As a result, it offers for adoption in the *Manual* a page covering the latter subject and three pages covering the former. No other recommendations are made, except a revision of the *Manual*, under the item engine houses, similar to that made last year. (Bulletin 194.)

Wooden Bridges and Trestles

A six-page discussion of the comparative merits of ballast-deck and reinforced-concrete trestles, with two short appendices giving formulas and tables of justifiable expenditures, forms part of the report of the Committee on Wooden Bridges and Trestles. The committee concludes, however, that the relative advantages are not susceptible to mathematical demonstration and that each case should be settled on its own merits.

The desirability of galvanized-iron fastenings for timber trestles was also investigated, and the committee presents in a seven-page appendix information received from various companies and individuals. The committee's conclusions indicate that it doubts the need for galvanized fastenings.

Progress is reported in the classification of wooden bridges, and in the investigation of the use of lag-screws for fastening guard timbers. The use of lag-screws by fifteen railroads is presented in a table, but the committee asks more time before making final recommendations. (Bulletin 193.)

Masonry

Recommendations for the *Manual* on four distinct subjects testify to the activity of the Committee on Masonry. The subjects are concrete piles, surface finishes of concrete, nomenclature and formulas for retaining walls and specifications for cement—Portland and natural. The committee presents for adoption specifications for constructing and for driving precast concrete piles. It also offers for adoption a page of information regarding cast-in-place piles.

As suggested at last year's convention, the specifications for surface finishes of concrete have been edited to eliminate the purely descriptive matter, and are recommended for adoption. The committee also recommends the acceptance of five general conclusions, which embrace those of a year ago, and in addition points to the desirability of rubbed margins and outlines, and urges the necessity for careful formwork and placing of the concrete. A number of illustrations of pleasing surfaces are presented.

Twenty-six pages on the principles of design of plain and reinforced retaining walls and abutments include

a large number of drawings of the standards of various railroads, nomenclature and formulas for retaining-wall design and an enumeration of nine principles to be observed.

The specifications for cement are to replace those now in the *Manual*. They are the result of the joint efforts of representatives of the numerous organizations that have been studying the question. (Bulletin 194.)

Signs, Fences and Crossings

Responding to the criticism at last year's convention of the plans submitted by the Committee on Signs, Fences and Crossings to cover track construction and flangeways at paved street crossings and in paved streets, the committee has gone into the subject further. It has not, however, found it advisable to revise the plan previously submitted. It states why at some length. It also presents a table of flangeway practice for 104 railroads.

As information, the committee presents a discussion of signs, the substance of which is that railroads use too many, and that more attention should be given to their design and location and to the securing of observance of them.

Considerable additional information on the subject of concrete and steel fence posts has been assembled by the committee and is presented.

Abstracts of laws relating to the providing of right-of-way fences and the installation of stock guards in the various states and in Canada occupy 22 pages.

The remaining subject assigned to the committee was a comprehensive study of grade crossings and their elimination. Because the committee had so much other work in hand and because a committee of the American Railway Association is working on the same subject, it has not attempted to make an extensive report this year. It has, however, assembled considerable information, which it presents. (Bulletin 192.)

Signals and Interlocking

A feature of the report of the Committee on Signals and Interlocking is a continuation of the technical analysis of the capacity of single track, begun in the report of last year. The second installment takes into account trains of different classes, and shows the great effect on freight-train capacity of the number and position of passenger trains. The length of the discussion precludes its presentation in this journal. Another feature is a 50-page analysis of the signal schemes which have been presented to the association.

In addition to these two extended discussions, the committee recommends for adoption a list of requisites of switch indicators, and reports progress in various other investigations assigned to it. (Bulletin 192.)

Records and Accounts

Numerous changes in the *Manual* are proposed by the Committee on Records and Accounts. They have to do with definitions, forms, track maps and charts and conventional signs.

Specifications for maps and profiles, conforming to the requirements of the government's Division of Valuation, are recommended for adoption, as are a large number of valuation forms assembled for field and office use.

The committee was instructed to report on any desirable changes in the Interstate Commerce Commission's classifications of accounts covering road and equipment and operating expenses. The committee holds that while minor improvements could be made, frequent changes are undesirable. It does, however, offer suggestions to serve as a basis or guide when the railways and the commission are ready and desirous of reviewing the various classifications. (Bulletin 194.)

Rules and Organization

The main work of the Committee on Rules and Organization has been the completion and classification of its investigation of clearances. The committee offers for insertion in the *Manual* the main conclusions proposed last year; minimum clearances to specific structures (for new construction) somewhat less than those objected to at the convention last year; the nine exceptions presented last year, and a new clearance diagram based on the action of the convention last year. [The diagram prepared by the Engineering Record and published in its issue of April 1, 1916, page 446, following the action of the 1916 convention, accords with that of the association, except that the latter gives qualifying requirements for curves of less than 800-ft. radius.]

Aside from its work on the clearance diagram, the committee reports progress in its investigation of instructions for the guidance of engineering field parties and for the employees of the maintenance-of-way department, and in its study of the science of organization. (Bulletin 195.)

Water Service

Except for a number of extensive revisions of the *Manual* to make the language clearer, the Committee on Water Service merely reports progress and presents information. The information, however, embraces discussions of methods for rejuvenating driven wells and their cost and success as compared with driving new wells; a report on various types of well strainers, and the use of and service secured from each type; one on methods for complying with federal regulations in regard to purity of drinking water, one on the relative merits of continuous and intermittent water softeners, and one on rules or examination questions for care of boilers in pumping stations. (Bulletin 193.)

Yards and Terminals

Three hump profiles—one for cold climates, one for moderate and one for warm climates—are recommended for adoption by the Committee on Yards and Terminals. These would replace the profile now in the *Manual*, which the committee desires to have stricken out. The committee would also strike out the sentence in the *Manual* allowing a grade of 2 per cent over track scales, substituting a provision that it should not exceed 1 per cent and should preferably be not less than 0.6 per cent. Considerable data obtained from various roads regarding humps and ladder types are presented as information. Drawings of twenty-seven ladder types show about every conceivable design, from the simplest involving a small number of tracks to the most complex where a quick spread to a large number of tracks is desired or where double ladders are used. They apply to both freight switching yards and passenger terminals.

Track-scale specifications similar in all respects to those that will be recommended for adoption by a committee of the American Railway Association are presented as information, as are data regarding nine double-deck freight houses. There is also a three-page appendix on the handling of L. C. L. freight by tractors and trailer trucks—Chicago Junction Railway. (Bulletin 194.)

Iron and Steel Structures

An account of impact tests made on the Norfolk & Western Railway during the summer of 1916 constitutes a large part of the report of the Committee on Iron and Steel Structures. The committee submits for adoption a substitute for the impact formula now in the *Manual*, the new formula being $I = 30,000/(30,000 - L)$.

A five-page progress report on present practice in the construction of ballast-floor bridges and methods in use for waterproofing them is presented without recommendations. A shorter report on methods of protecting iron and steel structures against corrosion is offered and a paragraph designating chilled cast-iron plates as the best form of protection to steelwork from locomotive blasts, and explaining how they should be placed, is recommended for insertion in the *Manual*. (Bulletin 195.)

Economics of Railway Location

Progress only is reported by the committee on economics of railway location, except in the matter of revision of the *Manual*. A number of changes are recommended for the *Manual*, these being chiefly condensing of the text. The committee recommends also a division of its matter under certain heads when the next *Manual* is issued.

An appendix by Prof. Edward C. Schmidt discusses the test of passenger-train resistance made last summer on the Illinois Central Railroad. (Bulletin 194.)

Wood Preservation

Specifications for creosote oil analyses, substituted for those now in the *Manual*, are recommended by the Committee on Wood Preservation. These have been prepared in co-operation with the committees of the American Society for Testing Materials and the American Wood Preservers' Association. No radical change has been made, but the committee believes it has made the specifications more precise and explicit, and it has also added a number of new features.

As a result of the continued investigation of water sampling in creosote oil, the committee recommends for adoption a clause to the effect that the principles of zone sampling be employed, using a type of apparatus shown.

Progress reports are made on exposure tests of ties treated with water-gas tar and on records of service tests. (Bulletin 195.)

Electricity

Fourteen additional definitions are recommended for the *Manual* by the Committee on Electricity. Aside from these, the committee reports progress only. Its report gives evidence, however, of considerable work. It has checked up the question of clearances and has seen that its diagram does not clash with that of the

larger diagram presented by the Committee on Rules and Organization. It presents considerable tabulated data regarding overhead clearances. It has also been collecting photographs, blueprints and other data, some of which it presents, relative to transmission lines and crossings. A 12-page progress report on maintenance organization and the relation to track structures is also supplemented by numerous illustrations.

In connection with the question of electrolysis, it has had published with its report the preliminary report of the American Committee on Electrolysis, on which it is represented. This report contains 152 pages. An introductory paragraph explains that it is intended to include only statements of fact, and that it does not attempt to draw conclusions, make recommendations or discuss questions of law. (Bulletin 191.)

Conservation of Natural Resources

A 26-page progress report by the Committee on Conservation of Natural Resources covers a wide range of topics, such as the conservation of timber, future metal supplies, coal wastes, smoke prevention, the use of pulverized coal and the question of water power or coal. Considerable space is given to the progress of conservation in Canada. A new feature of the report, suggested at last year's convention, is the inclusion of the conservation of human life and the discussion of safety-first movements. (Bulletin 193.)

Uniform General Contract Forms

Acting on several criticisms received by the special Committee on Uniform General Contract Forms of its blank agreement for industrial track submitted last year, the committee has revised the agreement, and recommends it for adoption.

Progress is reported on the other subjects assigned to the committee. (Bulletin 194.)

Grading of Lumber

Last year the special Committee on Grading of Lumber presented tentative specifications for Southern yellow-pine bridge and trestle timbers to be treated. With slight changes, the committee now recommends them for adoption in the *Manual*.

The principal subject assigned to the committee was to "draw up in unified form a second specification for construction timbers and building lumber for use on railways, showing each kind of quality of lumber or timber which was suitable for each of the different classes of work on a railway." This year, the committee has confined its work to establishing a broad general classification as to uses. This it submits as a progress report, asking for criticism.

The committee also reports that it has given considerable attention, in co-operation with the corresponding committee of the American Society for Testing Materials, to the desirability of formulating a density rule for Douglas fir similar to that adopted last year for yellow pine. (Bulletin 194.)

Stresses in Railroad Track

A brief progress report, similar to that presented at the January meeting of the American Society of Civil Engineers, is presented by the special Committee on Stresses in Track. Besides various tests of the appa-

ratus itself, field tests were made during 1916 on 85, 125 and 136-lb. sections of main line of the Illinois Central Railroad with Mikado, Pacific & Atlantic types of locomotives running at various speeds. Tests were also made on the Delaware, Lackawanna & Western Railroad with four types of locomotives on 105-lb. rail. In addition to the strains in the rail, track depressions were measured. Static tests were made to determine the bending in ties and stresses in track.

Laboratory tests on the distribution of pressure downward through ballast material have been carried on. Apparatus has been installed and tests have been made with stone ballast, gravel ballast and sand, using different depths of material and loads up to 50,000 lb. The work of reducing all test data has been carried on and the material is being put into satisfactory form for final record. (Bulletin 193.)

Cast 25-Ton Concrete Blocks for 38½ Cents a Yard

Three Half-Yard Mixers Mounted on Moving Platform and Supplied by Crane Pour 1242 Yards in 11½ Hours at Panama

By R. Z. KIRKPATRICK

Formerly Assistant Chief Hydrographer, Panama Canal

MOUNTED on a pair of flat cars running parallel to the casting yard and at sufficient height to deliver concrete by gravity, three ½-yd. mixers, supplied with material from a stock-pile trestle in the rear by a locomotive crane, made good records both for speed and for cost in concreting 25-ton blocks used for armoring the east breakwater in Limon Bay, Canal Zone. This breakwater, at the northern terminus of the canal, contains 682,000 cu. yd. of core rock and 67,500 cu. yd. of armor rock, in addition to a large yardage of 5.6, 10.6, 18 and 25-ton concrete blocks. All except the largest of these were made, and all were placed, by the canal organization. They were plowed off on the sea slope from Lidgerwood cars for the most part, the top sections be-

ing placed by derrick barges. The blocks were embedded in a small amount of soft rock, serving the purpose of cushion material.

LARGEST BLOCKS MADE UNDER CONTRACT

The 25-ton blocks, which are 7-ft. cubes and contain 12.3 yd. of concrete each, were manufactured under contract. The canal organization furnished gravel and cement delivered, and also supplied free use of second-hand material and equipment for the contractor's plant. The first 1500 blocks were made with 1 part of cement and 6 parts of run-of-bank Chagres River gravel. The remaining 10,500 blocks were made of 1 to 4½ concrete. In all, 12,000 blocks containing 147,600 yd. of concrete were made under this contract at \$14.7355 per block, or 38½ cents per yard. On one occasion 101 blocks containing 1242 yd. were cast in 11½ hours, representing an average hourly output of 108 yd. for the plant, or 36 yd. for each mixer.

PLANT MOUNTED ON FLAT CARS HAD CHUTE DELIVERY

The three mixers were mounted on a platform erected on two flat cars running on parallel tracks 14 ft. apart. In front of these tracks was the casting yard, about 50 ft. wide, beyond which were the loading and switching tracks and the storage yard. Behind the mixer tracks was an elevated trestle from which gravel was dumped into stock piles. The mixers were mounted high enough to enable them to chute concrete directly into the farthest forms, 40 ft. away. They were supplied by gravity from a 6-yd. hopper, which was kept full by a locomotive crane with a clamshell bucket. The crane ran on the stock-pile trestle 12 ft. behind the outside mixer track and 14 ft. above it.

Material was drawn from the hopper into a small measuring hopper through a sliding gate, the cement was added, and the batch discharged into the proper mixer through a system of sliding doors. Cement was received in box cars and raised to the mixer platform by Decauville cars, one of which at each end of the plant was operated on an inclined track by a hoist. Each elevator had a capacity of 10 sacks of cement a minute.

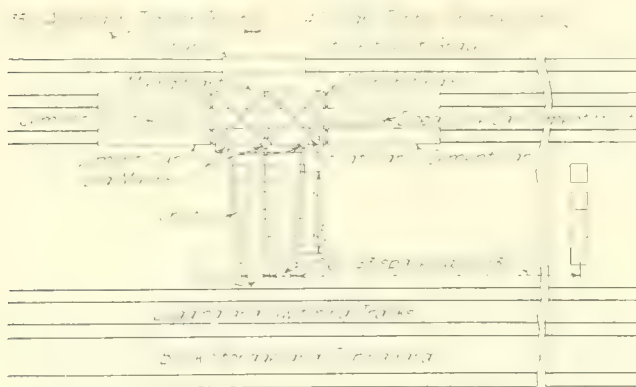


LONG, NARROW YARD WORKED IN ALTERNATE SECTIONS TO REDUCE FORM TRAVEL

The driving power for the entire plant was obtained from an old French locomotive which was coupled to the outside flat car and also used to shift the plant up and down the yard as required. The mixing yard was laid out in rectangular plan, with four rows of casting platforms parallel to the mixer tracks. Each 12-file section was grouped into a rectangle containing 48 blocks, with passageways between them for workmen. In pouring, every other rectangle of 48 was left, so as to permit the forms to be shifted with the least travel. Although 394 bases were required, only 180 sets of forms were used. These were stripped in 24 hours if necessary, and the blocks lifted from their bases and moved to the curing and storage yard in 72 to 96 hours.

FORMS MADE IN TWO PIECES

The bases were 9 ft. square and made of $\frac{7}{8}$ -in. lumber. The side forms, 7 ft. square inside, were made of the same size lumber and provided with bevel strips at all



THREE MIXERS, RUN CONTINUOUSLY, SUPPLIED FROM SINGLE BIN

edges. Two adjacent sides were nailed together solid, so that the complete side form for each block was handled in two pieces. In dismantling, wedge blocks, placed at the outside clamp pieces, made it easy to take down and move out a half form. Recesses on two opposite faces were cast in each block for handling. The blocks were lifted by a 40-ton Industrial Works crane using especially designed hooks weighing 2600 lb.

West Indian labor, managed by American foremen, was employed throughout the work. This labor is now quite efficient because of its long experience on the canal. The contractors for these blocks were Walker & Torbert, formerly superintendent and chief clerk respectively of Pacific terminal construction.

Cost of Catchbasin Cleaning

The average cost of cleaning city basins, including the cost of labor and team haul, for the District of Columbia during the year ended June 30, 1916, was \$0.297 per basin, the cost per ton of silt removed being \$2.15. For suburban basins the average cost of cleaning was \$0.565 per basin and \$0.859 per cubic yard for material removed. The cost of loading the material on scows, water transportation, unloading, and grading was \$0.925 per ton. A total of 10,914 cu. ft. of material was removed from sewers and 71,500 cu. ft. from the settling chamber of the disposal works, while 804,866 lb. of screenings was removed and incinerated. These figures are from the annual report of the Engineer Department.

Record Production of Lime in 1916, Says Geological Survey

Sale of Hydrated Lime Increases—Prices of Lime Higher—Bigger Demand Partly Offset by Higher Production Cost

LIME produced and sold in 1916 in the United States, including Porto Rico and Hawaii, indicates a total marketed production of 4,150,000 short tons. This is a gain of nearly 15 per cent over the total for 1915, which was 3,622,810 short tons, according to an estimate just made by G. F. Loughlin of the U. S. Geological Survey. This is also the first year in which the production of lime in this country has exceeded 4,000,000 tons.

Of the 43 states in which lime was produced and sold, 31 reported increases. The remaining states represented less than 6 per cent of the total quantity produced. The only states with outputs of more than 50,000 tons that showed decreases in 1916 were Michigan, which produced 80,000 tons, and Illinois, which produced 74,000 tons. Washington produced 25,000 tons—a decrease of 8 per cent over 1915. The estimated outputs of the states with a marketed production of more than 100,000 short tons are shown in the accompanying table.

Hydrated lime in 1916 showed an even more striking increase than total lime. The marketed production

ESTIMATED LIME PRODUCTION OF LEADING STATES IN 1916

State	TOTAL LIME		HYDRATED LIME	
	Tons	Per cent of gain	Tons	Per cent of gain
Pennsylvania	1,037,000	15	113,000	45
Ohio	529,000	4	339,000	8
Virginia	350,000	32	•	89
West Virginia	310,000	24	51,500	37
Wisconsin	259,000	17	•	20
Missouri	204,000	31	34,971	66
Maryland	168,000	29	31,500	65
Maine	152,455	11	•	34
Massachusetts	139,000	3	•	10
New York	124,000	7	7,000	190
Indiana	120,000	20	24,600	39
Tennessee	120,000	45	•	50

*Figures not disclosed, as less than three companies produced hydrated lime

amounted to 710,000 tons, which is a gain of more than 13 per cent. All states in which the production amounted to 5000 tons or more showed increases. These included Michigan, Illinois and Washington, in which the total production of lime decreased.

Prices of lime were generally higher in 1916 than in 1915, though in some places the increase was not great until the close of the year. Companies giving more specific information reported an increase in price of 8 to 20 per cent, or 25 to 60 cents a ton, over the average prices in their respective states in 1915. Business conditions were reported to be improved by a majority of companies and were called abnormally good by a few; but in some states the increased demand for lime was largely offset by the increased cost of production.

The Story of Imperial Valley Told in Moving Pictures

A moving-picture producing company of southern California is now preparing a feature film on Harold Bell Wright's book, "The Winning of Barbara Worth." The reels are to tell the true story of the conception of the great irrigation enterprise and the difficulties which attended the early stages of the development.

Standard Highway-Bridge Plans Used on County-Road System

Overflow Bridges Meet Unusual Conditions at Low Cost—I-Beams and Box Culverts Predominate—Little Structural Steel Used

By WILLIAM C. DAVIDSON

Waco, Texas



INCASED I-BEAM OVERFLOW BRIDGE REPLACES STRUCTURAL STEEL SPAN ON REALIGNMENT



STRUCTURAL STEEL SPAN WITH CONCRETE FLOOR TO CARRY HEAVY TRAFFIC ON A MAIN ROAD

IN the construction of the 488 bridges and culverts necessitated by the requirements of the McLennan County, Texas, highway system the methods of location and design were reduced to a minimum and standardized plans were used wherever possible. Of the total issue for roads and bridges amounting to \$1,075,000, approximately \$180,000 was expended on the bridges and culverts of the system.

With the exception of the larger structures and where conditions required special study, construction stakes for bridge or culvert work were set at the time the alignment of the road was being run. Grades having been determined from preliminary surveys, locating stakes were set with reference to this datum, usually one on either side of the road along the fence line where they were not disturbed by traffic. The line established by these stakes located the center line of the opening and information as to the distance to the center of the culvert and the distance from the top of the stake to the top of the top slab was marked on the stake. This procedure had to be modified with the more elaborate structures, such as the I-beam bridges and overflow culverts, but in general the contractor could secure enough information from the data given to allow him to locate the structure properly.

HOW SIZES OF OPENINGS WERE DETERMINED

From an inspection of the existing openings, if any, and from approximate estimates of the size of the drainage area, the size of the waterway required was determined. In many cases the watershed was so small that it was not a difficult matter, but in some instances the watershed covered so large a territory that its approximate area could not be determined from a casual inspection. Where the culverts to be built were small, no ravine sections were taken, but in all cases the distance from the grade to the flow line of the stream was determined. With blueprints made from standardized drawings, and with data of this simplicity, it was only

a question of minutes to prepare four copies of a plan for the opening. However, where the channel was large, requiring the use of an I-beam structure of one or more spans, and a ravine section had been taken, the data were plotted on profile paper in the office to assist in determining the height of piers. Where the channel was wide enough to require more than two spans, a special design was made, giving due regard to expansion joints and height of abutments and piers.

On stretches of road subject to overflow, where it was impracticable to try to construct an economical span, considerable time was spent in investigation and study. In some cases a special design was adopted, but usually a modification of the I-beam construction or of the concrete culvert was possible, which would allow inundation of the floor system during periods of extreme high water. Since all overflow bridges were built in connection with a stretch of concrete road on each side, this road extending to the edge of the overflow area, it was important that the high-water mark should be determined with reasonable accuracy.

TABLES SUPPLEMENT STANDARD DRAWINGS

Tables showing all dimensions for a culvert of a certain length, height and width of roadway were prepared, which gave the size, length and spacing of longitudinal and transverse steel, and the approximate quantities of concrete. These quantities were used for estimating purposes only, final payments being made upon actual quantities. Other tables were prepared for the I-beam bridges, and these, of necessity, went more into detail, giving approximate quantities of concrete in the substructure as well.

These standards covered both single and double openings, and the double-opening design was frequently used in series by simply noting the number of openings desired. Only a few dimensions of these bridges and culverts were standard, spaces being left for writing in all other data and dimensions. The plans and tables for

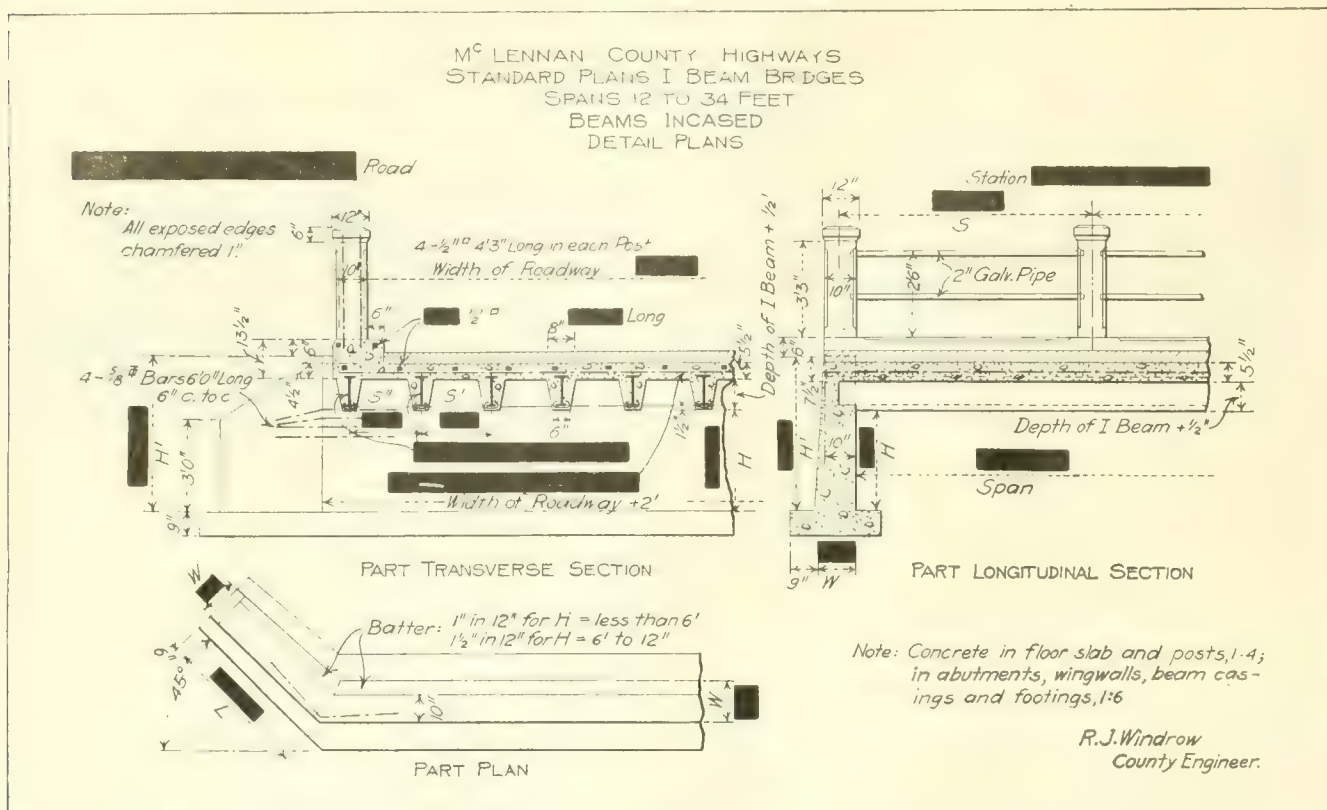
the box culverts called for spans ranging from 3 to 16 ft. and for the I-beam construction for spans from 12 to 34 ft.

CLASS OF ROAD AFFECTS DESIGN USED

Four general types of bridges and culverts were used on this work—reinforced-concrete boxes, steel I-beam bridges, structural steel bridges and pipe culverts. The

—16 ft.—practically all box culverts were built for roadways of 20 and 24 ft., the former being used on second-class and the latter on first-class roads. The height of box culverts varied from 18 in. to 6 ft., and when a greater height than this was necessary an I-beam span was built on account of its greater economy.

Retaining walls were made vertical on the face and battered 2 in. in 1 ft. on the back side, and abutments



MC LENNAN COUNTY HIGHWAYS
STANDARD PLANS I BEAM BRIDGES
SPANS 12 TO 34 FEET
ROADWAY 24 FEET

DIMENSIONS AND QUANTITIES

SUPERSTRUCTURE

SPAN	Steel Joists				S	Slab and Posts		Rail
	Beams Exposed		Beams Encased			Reinforcement	Concr	
	No. and Size	Wt 5' 5"	No. and Size	Wt 5' 5"		No. and Size	Wt (No. 1)	
12	2-6" 3/8 9-6" 1 1/2	38' 1.30 30' 30"	2-6" 3/8 9-6" 1 1/2	38' 1.30 30' 30"	12 0"	6 1/2" 4' 3" 22 " 26' 6" 595 18 " 3' 6" 24 " 4' 3"	6.84 6.84 6.84 6.84	
15	2-7" 3/8 9-7" 3/8	16' 8" 2.58 40' 30"	2-8" 3/8 9-8" 3/8	10' 8" 3.08 1.20 30' 30"	7' 11"	25 " 26' 6" 108 8 " 16' 6"	8.44 8.44	

INFRASTRUCTURE

Abutments		Wingwalls			Concr (No. 2)
L	* H' 1	A' 1	Concr (No. 2)		
4' 15 3/4	14.42	5' 8" 5' 8"	13'	4.37	
5' 1' 6 3/4	17.46	5' 0" 6' 8"	13'	7.20	

34	2-15" 3/8 10-15" 3/8	25' 8" 1.73 50' 30"	2-15" 3/8 10-15" 3/8	25' 8" 1.73 50' 30"	12 0"	22 " 4' 3" 25 " 26' 6" 1470 8 " 16' 6"	17.79 17.79 17.79
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12' 30 5/8	46.10	22' 8" 13' 6"	14' 2"	33.9
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Note: The beams, the fabric and the reinforcement for a dead end of the bridge are not shown. The fabric and the reinforcement for a dead end of the bridge are not shown.

* Note: These values for H' are calculated assuming a dead depth of 12' 0" and depth of beam differs from this, increase or decrease H', W and L proportionately.

R.J. Windrow
County Engineer

STANDARDIZED DRAWINGS AND REFERENCE TABLES MAKE THE DESIGNING OF BRIDGES AND CULVERTS A MATTER OF MINUTES

latter consisted of corrugated and vitrified pipe, depending on the class of road upon which it was used. Overflow bridges used in certain places involved the use of two general standards, and of special designs where standard drawings could not be employed.

Except in the case of overflow bridges, where the width of roadway corresponded with the width of road

were made vertical on the face and battered 1 in. in 1 ft. on the back. No attempt was made to obtain rock foundations for culverts of this nature, a firm clay or earth being considered satisfactory foundation material, since the bottoms of all culverts were paved with concrete and toe walls were used to prevent under wash of the footings and bottom slab. Only the top, or floor, slab

of the culvert was constructed of reinforced concrete.

The use of I-beam bridges was based on consideration of economy only. The width of roadway over structures of this type was varied to accord with the demands of traffic, usually being 20 ft. wide on first-class roads and 16 ft. on second-class roads, though these widths were not adopted as an absolute standard and some deviation was made from them. Except in the case of overflow structures, this type of bridge was provided with gas-pipe handrailing embedded in concrete posts. All footings were either extended to solid rock or to a firm clay or earth about 2 or 3 ft. below the flow line of the channel, and all walls were built at an angle of 45 deg. with the axis of the culvert. The I-beams were incased in concrete with wire mesh placed around the lower flange, and the floor slab was reinforced with longitudinal and transverse rods.

Only a few structural steel bridges were used on the system, and most of these were built under direct super-



BOX CULVERT OF 16-FOOT SPAN TO MEET OVERFLOW CONDITIONS

vision of the county engineer. All except one were built with wood floors and wood floor joists, the one exception being constructed with a concrete floor of 18 ft. width as against the 12 and 16-ft. roadways of the remainder. All such bridges were placed on reinforced-concrete piers and approaches were built of piling set on footings of concrete. This type of construction obtained only over the larger streams, where the shorter span I-beam design was not economical.

FACTORS AFFECTING DESIGN OF OVERFLOW BRIDGES

Both the incased I-beam bridges and concrete box culverts were used where the terrain indicated overflow conditions. In general, the design followed closely that of the basic type, with the exception that only a very low railing wall was provided. The railing was made low and massive, or eliminated entirely, to afford a minimum of resistance to the flow of water, thereby entailing less danger from the lodging of drift. Besides this detail, and the fact that all beams are firmly anchored to the abutments by reinforcing rods, all other features of design are identical with the general I-beam bridges and box culverts previously described.

All work on the McLennan County Highway System, including that on the bridges and culverts described in this article, was done under the direction of Rollen J. Windrow, county engineer of Waco, Tex., with J. M. Isbell and the writer as assistant engineers. With the exception of a few structural steel bridges built under the direct supervision of the county engineer, the work was done under contract by the McCall-Moore Engineering Company, of Waco, Tex., and the Richard Morey Construction Company, of St. Louis, Mo.

Graphical Analysis of Complex Reinforced-Concrete Beams

Sections with Steel in Various Locations Can Be Treated Graphically—Method Applied to Investigations and Design

By W. S. WOLFE

Instructor in Architectural Engineering, University of Illinois

APPPLICATION of graphical methods to the location of the neutral axis and the determination of effective depth and resisting moment of reinforced-concrete beams is here proposed for cases of complex sections where the steel is distributed as in beams reinforced for compression or where several layers of rods are used. It is assumed that graphical methods are familiar to the reader, and these methods will be illustrated both for investigating a given section and for designing a section to resist a given bending moment.

[Another article, treating the reinforced-concrete beam by analytical methods, written by J. H. Cissel, is printed on page 457.—EDITOR.]

TO FIND THE NEUTRAL AXIS

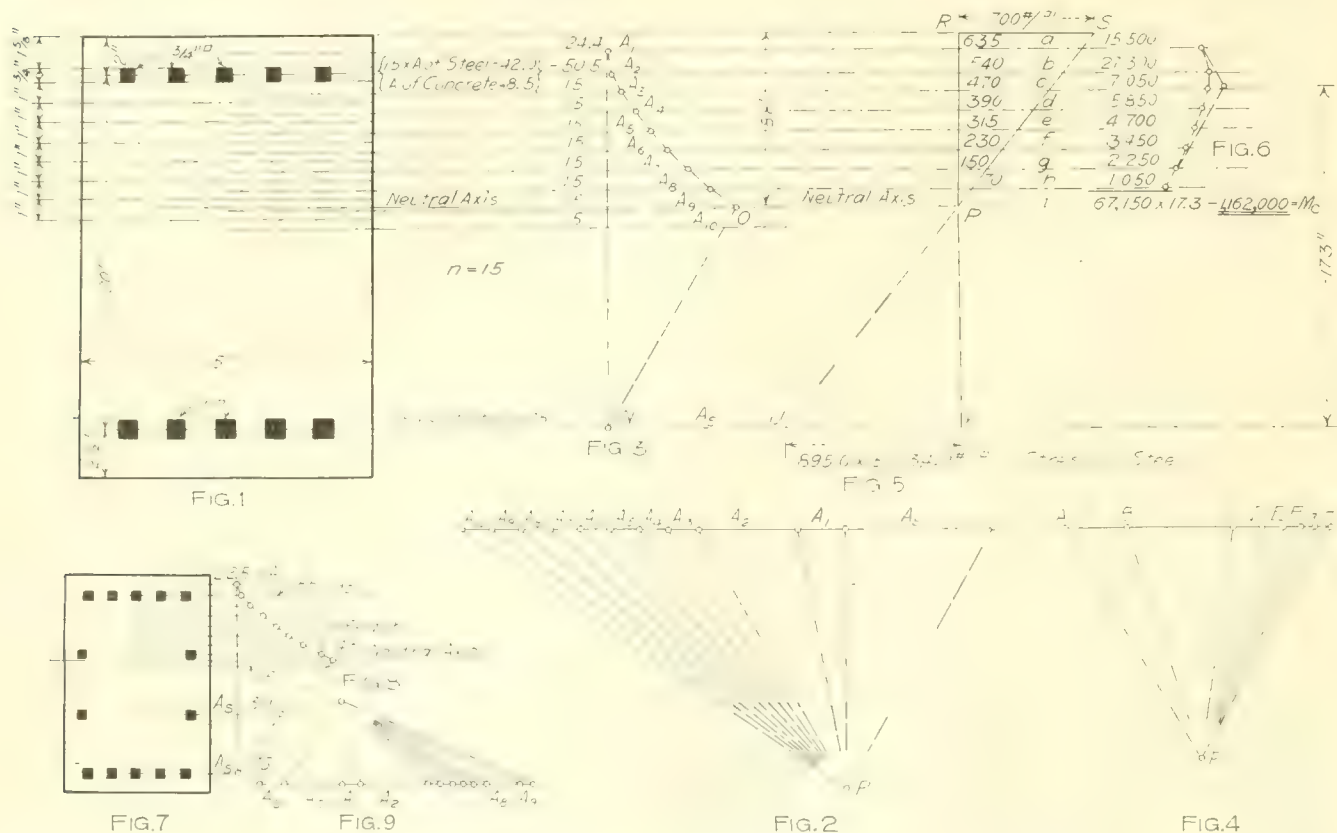
Consider the problem of finding the neutral axis and resisting moment of a given reinforced-concrete beam reinforced on the compression side, as in Fig. 1. Applying the usual method of finding the centroid of an area, the compression side of the beam is divided into thin slices, taken small in order to avoid large errors, and each slice is represented by a force A_s , A_s , etc. In order to obtain a homogeneous section, the area of the steel is always multiplied by $n = 15$, assumed for the ratio between the moduli of elasticity. The force diagram for these "area forces" is then drawn, Fig. 2, beginning with A_s at one end, A_s next, etc., as shown.

The funicular polygon for locating the resultant of these forces is then drawn, Fig. 3, and the intersection O of the line NO , with the lines parallel to the rays for the compressive areas, gives the position of this resultant, or the centroid of the section, and hence locates the neutral axis. Note that none of the area below O is used, according to the usual assumption that tension in concrete is neglected.

TO FIND THE RESISTING MOMENT

Now in Fig. 5 the point P is on the neutral axis, just found, RS is drawn to convenient scale to represent the allowable stress in the concrete, 700 lb. per square inch, and the straight line PS is drawn to represent the variation of stress across the section. By scaling the ordinates to this line at centers of the slices considered, and multiplying by their areas, the values of the resisting forces were obtained, after noting that the steel stress in tension is $UV \times 15$, or 13,400 lb., less than the allowable value, showing that the concrete governs. If the steel stress were found to exceed the allowable value, the line UV should be made $16,000/n$ to locate the stress line PS , and the steel would govern. The compressive forces are plotted in the force polygon, Fig. 4, in order to locate their resultant by the polygon, Fig. 6, at X .

Knowing the magnitude of the compressive forces, by summation, to be 67,150 lb., the effective depth is



NOTATION AND EXAMPLES ILLUSTRATING THE INVESTIGATION OF GIVEN SECTIONS

scaled off as 17.3 in. and the resisting moment is then $67,150 \times 17.3 = 1,162,000$ lb.-in. This has been checked closely by the usual formulas.

Application to complex sections, as Fig. 7, can be made as shown by Figs. 8 and 9, locating the neutral axis.

DESIGNING DOUBLE-REINFORCED BEAMS

To design a double-reinforced beam for a given bending moment, first assume the position of the steel and the allowable total depth, and assume a convenient width of, say, 10 in. and a proper value for the compression steel ratio p' . The stress line US is then drawn in Fig. 13 by making RS equal to the allowable compressive stress in the concrete (650) and UV equal

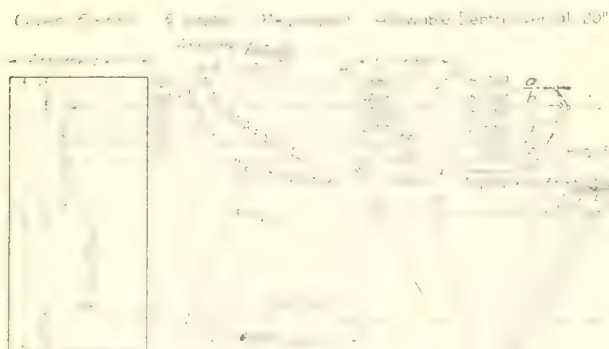
to the allowable stress in the steel in tension (16,000) divided by n (15), or 1066. The intersection P then locates the neutral axis.

The compression side is divided into a number of slices as shown, and the areas A_1, A_2 , etc., computed, knowing the value of A_s because the compressive steel area is known from the given ratio p' . To find the area of tension steel required, the value of A_s is obtained from the polygon, Fig. 11, and the force diagram, Fig. 12, using the closing line NO . A_s is then scaled off (31) and divided by n (15), giving 2.06 sq. in. for the area desired. The steel ratio p is then easily computed. The resisting moment is obtained as before, using the diagrams Figs. 13, 14 and 15, by which a resisting moment of 502,000 lb.-in. is obtained, as shown.

Now, if the width is increased and the steel ratios are kept constant, the resisting moment will increase directly as the increase in width. Therefore if the assumed width be multiplied by the ratio of the required moment to the moment obtained for this width, the required width is found. This computation, given on the diagram, shows that a 20-in. width is necessary. The required areas of steel in compression and tension can then be computed as given, knowing the values of the steel ratios p and p' .

Moving Troops by Automobiles

The capacity of any road for moving troops by automobiles may be computed about as follows: On roads paved over a width of 16 ft., two machines can travel abreast and, allowing 250 per mile for such a road, would deliver 7000 men per hour where wanted; that is about 3500 men per hour for each 8-ft. width of paved surface, the automobiles traveling 20 miles per hour.



TO FIND SECTION REQUIRED FOR GIVEN MOMENT

Literature

For the Civil Engineer and Contractor

New Publications

RIVETED BOILER JOINTS. By S. F. Jeter, B.S., M.E., chief engineer, Hartford Steam Boiler Inspection and Insurance Company. Cloth, 8 x 11 in.; 155 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company. \$3 net.

A treatise on the design and failures of riveted boiler joints, with numerous original diagrams enabling the design of any desired joint to be made without calculations.

THE DESIGN OF RAILWAY LOCATION. By Clement C. Williams, professor of railway engineering, University of Kansas. Cloth, 6 x 9 in.; 517 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$3.50 net.

REPORT ON VALUATION AND RATES OF CITIZENS WATER SUPPLY COMPANY OF NEWTOWN, NEW YORK CITY. By Delos F. Wilson, deputy commissioner, Department of Water Supply, Gas and Electricity, New York City. Cloth, 7 x 10 in.; 378 pages; illustrated. New York, Department of Water Supply, Gas and Electricity.

This report contains a complete account of the city's relations with the company. It was prepared after formal complaint had been made against the company's rates. The report deals with the valuation of the plant, its history, earnings and schedule of rates recommended.

STEAM BOILERS—THEIR THEORY AND DESIGN. By H. de B. Parsons, B.S., M.E.; professor emeritus of practical engineering, Rensselaer Polytechnic Institute. Cloth, 6 x 9 in.; 377 pages; illustrated. New York and London, Longmans Green & Company. \$4 net.

STRENGTH OF SHIPS. By A. J. Murray. Cloth, 6 x 9 in.; 400 pages; illustrated. New York and London, Longmans Green & Company. \$5 net.

THE CO-OPERATIVE SYSTEM OF EDUCATION. By Clyde William Park, associate professor of English, University of Cincinnati. Bulletin 37, U. S. Bureau of Education. Paper, 6 x 9 in.; 48 pages; illustrated. Washington, Government Printing Office.

INSTRUCTIONS TO LOCATING ENGINEERS. By F. Lavis. Cloth, 6 x 9 in.; 44 pages; illustrated. Reproduced in abridged form from the author's "Railroad Location Surveys and Estimates." New York, McGraw-Hill Book Company, Inc. \$1 net.

A LOGARITHMIC STADIA REDUCTION TABLE. By Francis S. Foote, Jr. Paper, 7 x 10½ in.; 12 pages. Berkeley, Cal. Publication in Engineering No. 11. 10 cents.

FAILURE OF BRASS. 1—Microstructure and Initial Stresses in Wrought Brasses of the Type 60 Per Cent Copper and 40 Per Cent Zinc. By P. D. Merica and R. W. Woodward. Paper, 7 x 10 in.; 72 pages; 120 figures. Bulletin 82, U. S. Bureau of Standards. Washington, Government Printing Office.

Books Reviewed

Arithmetic for Engineers

Author, Charles B. Clapham, lecturer in engineering and elementary mathematics at the University of London, Goldsmiths' College. Cloth, 6 x 9 in.; 436 pages; illustrated. New York, E. P. Dutton & Company. \$3 net.

This is a comprehensive, practical treatment of the most elementary parts of mathematics, including simple algebra, mensuration, logarithms, graphs and the slide rule. It is written for students of most limited training; in fact, in the endeavor to make all points perfectly clear to this class of readers the explanations and practical examples are given with most comprehensive care, even to the extent of becoming verbose.

The most important feature of the text is the use of at least one practical example to illustrate every principle or procedure described. This results in a fully illustrated volume, filled with stimulating exercises using engineering subjects, presented in a satisfactory form typographically. It should be emphasized, however, that the text is written for elementary students and is in no sense a handbook for reference.

Concrete—Plain and Reinforced

Authors, Frederick W. Taylor, M.E., Sc.D., and Sanford E. Thompson, S.B. Third edition, revised and enlarged. Cloth, 6 x 9 in.; 885 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$5 net.

This well-known treatise on concrete and reinforced concrete is now brought up to date by revisions and new material, largely by S. E. Thompson following the death of Dr. Taylor, the senior author. The new edition contains the results of recent developments in theory, design and tests, several chapters being rewritten almost entirely. Other chapters are rearranged and revised to accord with the latest information on the subjects considered, and to include the revised specifications of the joint committees of national societies. For example, the old chapter on reinforced concrete is enlarged and divided into three chapters—one on theory, one on test and one on design. The chapter on building construction is rewritten and now contains many drawings of recently completed concrete structures of various types, including details of formwork, etc.

A new chapter of 12 pages is added to give examples of the design of beam bridges, including slab bridges, deck-girder spans and through-girder spans, with a short statement on continuous-girder bridges. The chapter on chemistry of hydraulic cements, by S. B. Newberry, is revised and new results of experiments are suggested, but not discussed in full. The two chapters on mixing and depositing concrete are rewritten and the results of recent experiments included. The chapter on arches, by F. P. McKibben, remains substantially the same, except that the material on stress distribution has been rewritten and transferred to the chapter on theory of reinforced concrete, where the diagrams to facilitate computation are included. It will be recalled that the book includes chapters by R. Feret and W. B. Fuller in addition to those already mentioned.

It is unnecessary to remind engineers that this book has had exceptional success as a practical and reliable treatise on this subject. In its present form it is a thoroughly modern text presenting the latest data in the field of concrete and reinforced concrete.

Valuation, Depreciation and the Rate Base

Authors, C. E. Grunsky, Eng. and C. E. Grunsky, Jr., E.M. Cloth, 6 x 9 in.; 387 pages. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. \$4 net.

REVIEWED BY C. W. STARK

Associate Editor Engineering Record

Although this volume is rightly named, in that it discusses all of the subjects mentioned, its appeal to engineers will not be in its treatment of the general principles of valuation, which have been better and more fully set forth elsewhere, but in the extended discussion of depreciation and its effect on the rate base and in the elaborate tables that occupy nearly a third of the book. The authors are not gifted with great clarity

of expression, and the reader is sometimes left in semi-obscure as to what is meant. But dissertations on depreciation will probably never supplant the popular magazines for light reading. The authors are fundamentally sound in their refusal to deduct from the rate base, as depreciation, a part of the investment; and though they call the replacement method the unlimited-life method, and wrap it up in several pages of mathematical equations, this may be due to the fact that the last and best report of the American Society's valuation committee had not appeared when the book went to press—though it has reached the public's hands ahead of the book.

A general introduction and definition occupy the first two chapters. The third chapter, "Fundamental Principles," is very short. The first sentence, however, sounds the keynote of the author's theory—that the earnings of the property should be such that, within the life of the property, there will be returned to the owner his capital, with interest. There are those who prefer to think that the owner's capital shall not be returned to him at all, but shall be allowed to remain permanently in the plant; and even though the authors meet these views mathematically by making the life of the property infinity, they are likely to think this is using a cumbersome process to demonstrate a simple truth. In this chapter, also, the authors introduce methods of depreciation. One of these they unfortunately call the equal-annual-payment method, though the American Society's committee has rechristened this the compound-interest method.

"Essentials of Value" constitutes a fourth chapter, dealing mainly with overhead and intangibles, and then comes a chapter on "Elements Which Reduce Value," in which the authors really begin their microscopic analysis of depreciation, amortization and replacement. It must not be supposed, however, that they stand with the theorists who blithely assume that the exact life length of each item of plant can be set down. On the contrary, a considerable part of their discussion has to do with the large majority of items that die too soon or live too long. Chapter 6 begins this phase of the discussion.

Chapter 7 is on the purpose of the appraisal, Chapter 8 on the fixing of rate and Chapter 9 on possible procedures in fixing rates. The authors never get far from the depreciation question, and present numerous figures and tables for sober study. A brief chapter on land, in which the authors refuse to be frightened out of their senses by the Minnesota rate decision, is followed by a longer one on the value of water rights and watershed lands. These latter subjects have not had too much attention, and the chapter is a good one.

Chapter 12, on the accounting system, is not so good, for it is not up to date. For example, under the heading "Treatment of Depreciation and Replacement, Interstate Commerce Commission," there is no mention of the policy of the Division of Valuation, made public nearly a year ago. Such of the matter as is of value seems to belong somewhere else in the book.

Chapter 13 is on the valuation of mines and oil properties. Few civil engineers, of course, will need it, but with its 33 pages, including production tables, diagrams and a bibliography, it should be very useful to those concerned in its subject.

Chapter 14, tables and their explanation, occupying 105 pages, is the really distinctive part of the book. Although there are eighteen tables preceding this chapter, the reader will find here what he will hardly find anywhere else—probable life lengths of hundreds of items of plant, the authors' authorities given; expectancy and remaining value for life lengths from 5 to 60 years; and a variety of compound-interest, annuity, present-value and amortization tables for a wide range of time periods and interest rates.

In conclusion, then, the reviewer commends the book to the libraries of valuation men, not because it is a model of clearness, nor even because he thinks the depreciation problem is as desperately complex as the authors make it, but because the authors have painstakingly expounded a fair-minded theory about which valuation men should know something, and because they have presented some remarkably complete tables.

Selling Your Services

Cloth, 6 x 9 in.; 176 pages. New York, 627 Madison Avenue, The Sales Service Company. \$1 net.

This is not a wonder-working book which will enable a person without qualifications to get a big job. It does tell, however, in a very practical way how one can get a hearing and best present his merits in connection with vacancies which he is fitted to fill.

The book is well worth the reading of anyone seeking a position.

Handbook of Engineering Mathematics

Authors, Walter E. Wynne, B.E., and William Spraragen, B.E. Limp leather, 4 1/4 x 6 3/4 in.; 220 pages; illustrated. New York, D. Van Nostrand Company. \$2 net.

This book, intended primarily for students in engineering, is a handy means of reference to theoretical and applied mathematics, and includes, in addition, the principal constants and formulas for strength of materials, hydraulics and electricity. The solution of differential equations is given in a practical form, and all the important fundamental formulas of calculus are tabulated in a manner very convenient for ready reference. This part of the book will probably prove to be most useful to those engineers in actual practice who desire to apply exact methods of calculus to such problems as can be solved in that way—and it must be admitted that in too many cases engineers have been deterred from mathematical solutions of problems because of lack of familiarity with these tools.

The highly condensed form in which the formulas are presented makes it possible to include in the 214 pages not only those of algebra, geometry, trigonometry, analytic geometry, and calculus, but also hyperbolic functions, theoretical mechanics, mechanics of materials, hydraulics, and electricity, together with the usual tables of weights and measures and physical and chemical constants.

This book will prove to be extremely valuable not only to engineering students but to all practising engineers who desire a handy reference tool to give them immediate facility in the application of mathematical formulas and methods to the solution of practical problems.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Professional Unity vs. Internal Strife

SIR: As noted in the Engineering Record of March 3, page 365, H. J. Burt, president of the Western Society of Engineers, in addressing the Iowa Engineering Society, called attention to the tendency among employee engineers to invoke the principles of unionism.

It is not with the intent of giving counsel to employers or employees that I submit these remarks, but I offer such assistance as I am able to give to prevent the domination of engineering work by union practices. Union is based on co-operation for the good of the members. This is the principle, whatever the practice. Observation shows that co-operative enterprises fail except in cases where necessity demands co-operation. Under conditions favorable to its growth, co-operation has surpassed the bounds of reason. Such has been the history of unionism in this country. Opposition to organized labor has added the spur to action and unionism has become dictator in numerous lines of activities. If causes similar to those which contributed to the inception of trades unions exist in engineering work, we can, from past experiences, predict with reasonable certainty the outcome.

The start of unionism in Chicago is only one phase of co-operative developments extending over a period of years. Activities have not been confined to Chicago, but are fairly widespread. There are to-day scattered throughout the country a number of independent organizations of engineers working for the solution of the problem of how to deal with fluctuating economic conditions, in competition with organizations of similar nature in nearly every line of work. Stated in another way, this is the problem of how to obtain from the ultimate consumer sufficient return for services to enable the employee engineer to meet the demands made upon him. It is quite useless to argue that the cause is not sufficient to produce an effect. The measure of the cause is the demand made upon the engineer as a man and his ability to pay his bills. The very persistence in the effort to find a solution for this problem is an indication of its importance.

In justice to these organizations it should be stated that in many, if not all, cases they started with a fair and open-minded purpose. The fact was clearly established that employing engineers were not responsible for the cause and that they could not, unaided, apply a remedy. The idea has been held that an organization of both employers and employees could place engineering on a basis to compete fairly with other lines of work for a favorable place in the organization of social and civic activities.

Some employers have not taken kindly to the proposition. Others have expressed themselves as helpless and stated frankly that it is up to the employees themselves. Attitudes vary all the way from friendly to antagonistic. The same range of feeling exists in the ranks of em-

ployees, but I believe the antagonism to organization is becoming less as the need becomes greater.

There is a growing feeling on the part of the employees that the employing engineers stand between them and the remedy—not as an enemy but as a stone wall. Herein lies the undesirable feature of the movement as concerning employees and employer alike. There is danger that conditions may become acute and sentiment will crystallize so as to bring about strife between employer and employee. This would be disastrous to the engineering profession, and particularly so to those organizations which do a purely engineering business and have nothing to sell except service.

The best that can be hoped for is that the engineering profession will prove itself superior to precedent and not try to settle a question which concerns both employer and employee alike by encouraging internal strife.

Chicago. C. E. SCHUTT,
Electrical Engineer.

Motor-Truck Regulation

SIR: The discussion started in the Engineering Record of Oct. 28, 1916, page 519, is a most timely one and should receive the careful consideration of every person interested in highways, but especially of highway engineers. While in Yellowstone Park we have to date only a few miles of modern hard-surfaced roads, such as macadam finished with asphaltic oil, yet the problem of regulating the width of tires and weight of loads has been under consideration for a number of years by the engineer officers in charge. Indeed, through the efforts, several years ago, of Gen. H. M. Chittenden, Corps of Engineers (retired), all persons doing freighting in Yellowstone Park were obliged to use wagons with 4-in. tires. Many of the present roads had been newly constructed at that time and had been more or less thoroughly surfaced with natural gravel, helped out in a few instances by crushed rock. The wider tires did not apply, however, to passenger-carrying coaches; and as some of these coaches were drawn by six horses and were built to hold nearly thirty people in addition to baggage, the weight sometimes reached 1000 lb. per inch width of tire. This coach traffic was very severe on the roads.

It is probable that more attention was given to the width of tires for freight wagons than for coaches, because most of the freighting was done prior to and during the first weeks of the tourist season in the spring and at the close of and after the tourist season. For this reason the coaches operated generally during the most favorable, driest months, while the freight wagons operated when the frost was entering the ground or just coming out. This early-and-late freighting over roads subject to alternate thawing and freezing, coupled with the sheep-like traits of all freighters to travel exactly in the track of all preceding freighters, resulted in cut-

ting the roads very badly. Indeed no freighter, to my knowledge, was ever known to get out of a rut until it got so deep that he was stuck or his load overturned.

This condition is mentioned somewhat at length for the reason that the wider tires probably did much less to save the roads than the originators of the idea thought, or than most people now think. The freighters did exactly what the motor-truck builders and motor-truck operators are now doing: they increased the weight of their loads to the limit which the road would stand, putting on sufficient animals to haul the load. That motor-truck builders and operators will continue to do the same is human nature and bound to occur unless restricted by properly drawn and enforced laws. While the heavily loaded freight wagon with steel tires was bad enough, a steel-tired trailer or truck is far worse on account of the speed and weight of the loads. Accordingly, from my observations I am inclined to agree with those who would require rubber or other type of cushions on all automobile and trailer tires.

In this connection I noted about two years ago on the harbor boulevard between Los Angeles and its harbor that the track of the steel trailer wheels could be followed for miles, whereas trucks with rubber tires made no impression whatever. I do not think tenable the contention of motor-truck builders that if motor-driven vehicles and all trailers operated by them are required to have cushion tires the same should be stipulated for animal-drawn vehicles. I base this opinion solely on the increased speed of the trucks. The hammer effect of heavy loads on solid tires at high speed is too well known to need comment, and nothing less smooth and hard than the rails of a railroad will stand much of such abuse. There are, and always will be, slight inequalities in every highway, and wherever a heavy load with steel tires strikes these inequalities disintegration will begin and continue at an ever-increasing rate unless immediately repaired.

I note reference in the discussion to a limiting width of 90 in. for trucks. This ought to be sufficient, and certainly if it does not prove so will enforce consideration of wider roadways. Length and width of trucks in general are of somewhat less importance in country districts than in cities where traffic is so heavy during much of the time as to require several lines of vehicles; and it may be readily found that a size and width of truck that can be operated successfully in small towns and country districts will have to be debarred from operating in large cities or restricted closely to certain streets.

There seems to be for a great many classes of traffic a reversion of sentiment from heavy trucks and heavy loads to lighter trucks and higher speed. On oil or tar-finished roads or concrete roads, where speed does not destroy the surface, this change of sentiment is a good thing. On other classes of roads the reverse may be true. For instance, observation of automobile and truck travel through Yellowstone Park during the season of 1916 indicates that touring cars and high-speed, 2-ton trucks are easier on comparatively wet or muddy roads than the slow-speed, heavily loaded trucks. When the roads get dry, however, the reverse is true, the high speed trucks abrading the road material and forming dust very rapidly, while the slower speed and heavy load of the other type of truck tend to smooth down and run

over the dust. In wet weather the slow-speed truck in natural soil roads must have chains or some other means to prevent slipping. These chains tear the road very badly. In 1916 nearly 4000 automobiles and light, high-speed-trucks made the trip through Yellowstone Park, but there was only a comparatively small number of heavy trucks. This distribution, combined with the dry season, caused the wear on the roads from the high-speed machines to be much greater than that from the trucks. With a large increase in heavy trucks and a wet season, the reverse will probably occur.

We are now introducing into the park trucks of from 5 to 5½ tons weight, the trucks being built to haul loads about equal to their weight, making the maximum weight of truck and load 20,000 to 22,000 lb. These trucks are approximately 7 ft. in width, and on our 18-ft. roadways I find it advisable to pass them in an automobile with care; otherwise, I am in serious danger of striking them or of getting off the road.

It would seem that truck builders might well learn from the experience of railroads. I believe it is generally conceded by railroad engineers that a gage of 6 or 7 ft. would result in a great deal of economy over the present standard gage of 4 ft. 8½ in. But all thought of making such a change has been definitely given up, at least for the present, on account of the hundreds of millions of dollars invested in roadbed, rolling stock, tunnels and all other parts that go to make up a great railroad system. In the same way this country has now spent hundreds of millions of dollars on more or less permanent highways that are able to stand a certain traffic and certain loads. The public cannot afford, and will not consider, rebuilding these roads to care for the immensely heavy trucks and trailers that certain manufacturers and users would like to build and use, and it would be well for them to recall the whirlwind that the policy pursued by the railroads a generation or two ago of "the public be damned" has brought down upon them within the past ten years. It certainly would be to the vast interest of automobile truck builders to determine the loads that roads will bear safely and build their trucks accordingly. If they do not, the users of their trucks, and naturally the builders themselves, will suffer from the restrictive laws that will be passed, not only by every state but by nearly every city, county and village in the land.

Portland, Ore.

AMOS A. FRIES,
Major, Corps of Engineers.

A New Era in Teaching English to Engineers

SIR: I have read with much interest the articles in the Engineering Record of Feb. 24, page 291, on the teaching of English to engineers, and also the editorial on the same subject.

For the last ten years I have devoted considerable time and thought to this subject as perhaps one of the most important in engineering education. Several years ago I addressed a series of letters to some of the older Purdue graduates and also to firms employing graduates, asking for criticisms and suggestions concerning the technical course we offer. The comment of both graduates and employers was almost uniformly favorable, and but little criticism was offered on the technical work.

There was, however, a surprising unanimity in criticism of the English attainments of engineering graduates. This was not confined to the letters received from employers, but was also noticeable in the replies from graduates. The opinion was freely expressed that college students were not able to speak and write their mother tongue correctly.

As I suppose is the case at other institutions, the difficulty here arises from a lack of collaboration between the English department and the engineering schools. The teacher of English usually regards his subject as sufficient unto itself and regards its application to technical writing as a secondary matter. The student realizes this and naturally fails to see any connection between English and engineering.

We are endeavoring to remedy this state of things and have made considerable progress. The introduction of new courses in debating and journalism has given a practical trend to the English instruction. Elective courses during the junior and senior years are now offered for engineering students. Furthermore, any student who shows a lack of training in preparing reports or other written matter can be sent back to the English department for further instruction. Seminar courses in the speaking and writing of technical English are given in the senior year. In the remodeling of the curriculum which is now being worked out here, more emphasis is being laid on fundamental subjects, especially language, and the amount of time devoted to technical work is correspondingly reduced.

In comparing the articles by Professor Park and Professor Aydelotte, I see no necessary conflict between them. Professor Aydelotte urges the laying of a broad foundation in English and the cultivation of a proper attitude toward literary subjects and a living connection is established between English in the learning and English in the application. Professor Park emphasizes the writing of technical English and the more practical applications of English composition. It seems to me that these two suggestions supplement each other, and I would suggest a sympathetic attitude on the part of English teachers toward the subject of technical writing which shall prepare the way for more specialized courses like those outlined by Professor Park for the junior and senior years. I believe that every one of the four years in college should see a certain amount of English training and that this may be so connected as to keep the subject continually before the mind of the student.

C. H. BENJAMIN,

Dean, Schools of Engineering, Purdue University.
Lafayette, Ind.

Proposed Specifications for Structural-Steel Buildings

SIR: Kindly permit me to comment on the proposed specifications for structural-steel buildings, by R. Fleming, appearing in your issue of Dec. 9, 1916, page 708. Mr. Fleming gives 500 lb. per square inch for tension on rivets, then he virtually forbids the use of rivets in tension and gives bolts the preference. Tension on rivets cannot be avoided. Why not recognize this and make provision for proper details? (See my book, "Steel Designing," page 454.) Rivets seal up a joint and cannot work loose. Nuts are apt to work off, especially if there

is jarring, or they may never be made tight. I have found it extremely difficult to get a contractor to use good bolts or to tighten nuts. Half a dozen bolts generally give more trouble than a hundred rivets.

Riveted joints can be controlled by the draftsman, for the contractor knows he has to drive rivets. But a little note on a tracing that a certain connection must be made with tightly-fitting bolts may produce nothing more than a few soft, loosely fitting erection bolts.

Mr. Fleming states that plate girders may be proportioned by their moment of inertia. Why? The other method is simple and definite and gives equivalent results, in general. He should state whether gross section or net section is meant. The former would not be correct; and the latter, if only tension holes be deducted, would introduce extreme complication.

He would make girder webs $1/160$ of the clear depth in thickness. This is extremely severe for building work and is uneconomical. I have known of much railroad work where the ratio was less than $1/200$. The latter is, however, a good lower limit.

He would design girder stiffeners as columns. Why? There is no column action in intermediate stiffeners. They simply hold the web flat. The web takes the shear. Furthermore, he calls for 56,000 to 64,000-lb. steel. Why not specify 55,000 to 65,000, the standard now very generally used?

Pittsburgh.

EDWARD GODFREY.

[The foregoing letter was submitted to Mr. Fleming and his reply follows.]

SIR: Referring in sequence to the points raised in Mr. Godfrey's letter: Bolts in tension are given preference to rivets in tension where "the loads carried are subject to shock." In the common case of trolley beams which may be fastened to the bottom chords of roof trusses by bolts or rivets passing through the top flanges, bolts are to be preferred. The shock or impact from the moving trolley on the lower flanges is liable to snap the heads of rivets. The check nuts specified will keep bolts from working loose. In high office buildings with wind bracing without diagonals, rivets in tension are generally used for the connection of gussets to columns.

It is often desirable that girders be calculated by their moments of inertia, especially when they are to be compared with rolled beams of the larger sizes. Tests show that girders and beams fail in the compression flange; that is, the tension flange is the stronger of the two. For this reason I see no objection to the gross section being used, though not theoretically correct. However, as the excess over the allowable tensile stress mentioned elsewhere in the specifications is liable to be worked overtime, it might be well either to specify that in calculating the moment of inertia deduction of area shall be made for holes in the tension flange or to omit the words "Plate girders may also be proportioned by their moments of inertia."

Incidentally, it may be noted that the section in the building code of Pittsburgh relating to girders begins: "Rolled I-beams and channels and built-up members used as beams and girders shall be proportioned by their moments of inertia. Plate-girder webs shall have a thickness not less than $1/160$ of the unsupported distance between flange angles."

The specification calling for girder webs to have a

thickness not less than 1/160 of the unsupported distance between flange angles allows a 1/4-in. plate to be used for 40-in. clear distance, a 5/16-in. plate for 50 in. and a 3/8-in. plate for 60 in. These thicknesses do not seem severe or uneconomical. Railroad engineers would certainly object to girders having a distance of 50 in. between flange angles, practically 5-ft. girders, with webs only 1/4 in. thick.

The paragraph regarding stiffeners is faulty in not clearly expressing the meaning intended. Only the stiffeners over bearings and under concentrated loads need be designed as columns.

The ultimate tensile strength of 56,000 to 64,000 is that given in the specifications of the American Railway Engineering Association and has been followed in the majority of buildings of which the writer has personal knowledge. The 55,000 to 65,000 of other specifications is coming into more general use and there is no objection to their being substituted for those given.

New York.

R. FLEMING.

Inclined Tunnels Used Thirty Years Ago

SIR: The description in your issue of Feb. 24 of the skillful work done by the Foundation Company in connection with the strengthening of the foundations under the power house on the American side of Sault Ste. Marie brings to my recollection a report which I made to the Consolidated Lake Superior Company in May, 1903, on the condition of the pile foundations and what ought to be done to make them safe against the lateral pressure from the water dammed up behind the power house. In my report I recommended the very method of inclined pneumatic cylinder struts filled with concrete that has at last been adopted and carried out. The long delay of 13 years is probably due to the financial inability of the company to have the work done sooner.

Inclined caisson struts for taking up lateral forces in foundations were used long before that, in 1886, for strengthening the west abutment of the Chestnut Street bridge in Philadelphia over the Schuylkill River, built in the early 60's. This structure is an arch bridge of two spans with cast-iron arches. The west abutment is a mass of masonry resting on a pile foundation which commenced to give way under the thrust of the arches some years after completion of bridge. It was proposed in 1884 to strengthen that abutment and stop its further movement by sinking a big caisson foundation back of it down to rock, estimated to cost \$180,000. I made a plan for two inclined caisson struts, carrying the thrust of the arches directly down to rock. The plan was appropriated by the city without compensation to me and carried out at a cost of \$50,000. It was the first time, as far as I know, that such a construction was proposed and used, so that I may claim to be the originator of it.

GUSTAV LINDENTHAL,

Consulting Engineer.

New York.

[It was not the intention in the preparation of the article in question to take up the origin of the method employed, or to credit its suggestion to anyone mentioned in the article as connected with the work. In view of Mr. Lindenthal's letter, however, it was thought proper to submit his statement for public confirmation to Mr. Davis, general manager of the Michigan Northern Power Company, whose reply follows.—EDITOR.]

SIR: Referring to Mr. Lindenthal's letter regarding the article on page 292 of the Engineering Record of Feb. 24, 1917, describing work done on the reinforcement of the foundations of the power house of the Michigan Northern Power Company at Sault Ste. Marie, Mich., it is proper and fair to state that Mr. Lindenthal was the first to suggest the idea of buttressing the power house of this company with pneumatic cylinder struts, recommendation along which lines was made, as Mr. Lindenthal states, in his report to the then Consolidated Lake Superior Company in May, 1903.

The article in question was written from the contractor's viewpoint, primarily to describe the construction methods on the work, but not at all to discuss the various designs which had been considered in connection with the work. If such an article should be prepared, due credit will be given to those who have suggested various ingenious solutions of the problem to be met.

L. H. DAVIS,

General Manager, Michigan Northern Power Company.
Sault Ste. Marie, Mich.

Swaying the Level Rod

SIR: In S. Groman's article, "Swaying of Level Rod Causes Errors in Readings," printed in the Engineering Record of March 10, page 381, the errors cited exist for the swaying of the rod on a flat surface or on a point not in the plane of the face of the rod; but as only these cases are considered, his conclusion that swaying should be prohibited ought not condemn the practice as a whole.

When a rod bubble is not available the following method will eliminate the errors caused by swaying: For turning points a stake is driven firmly into the ground and a finishing nail driven to within 1/8 in. of the top of the stake. A cross-mark in the plane of the face of the rod and midway of the sides of the rod is made on the bottom of the rod, and the center of the cross set over the nail. In swaying the rod the point (nail head) remains in the same plane as the face of the rod.

CHARLES F. NIMMO.

U. S. Engineer Office, Dam 33, Ohio River.
Maysville, Ky.

Gain in City-Planning Movement

During the last year nearly 45 per cent of the cities of more than 100,000 population in the United States and 15 per cent of the cities of from 25,000 to 100,000 population have made important and constructive advances in city planning, according to George B. Ford, chairman of the committees of the American Institute of Architects, in an address before the annual convention of the National Municipal League, recently held at Springfield, Mass. The activity developed throughout America among semi-public or official bodies and in the legislatures of many states is said to be unprecedented. At a meeting of the National Conference on City Planning held last June a committee was appointed to study the possibilities of securing a national bureau for city planning and municipal investigation. In regard to city planning in general, Mr. Ford states that enormous strides are not only being made in the United States and Canada, but in France, England and even in India, and that never has the movement enjoyed a more hopeful and constructive year than the past.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Field Telephone With Handy Clamp Connections Invaluable on Road Work

By C. A. HOLTON

Division Engineer, Vermilion County Bond Roads,
Danville, Ill.

GOOD USE was made of a field telephone on division 7 of the Vermilion County bond-issue roads. There was a telephone led along the road under construction, as is the case with almost all roads to be improved. The telephone company went along the line and placed drop wires about 1000 ft. apart. These drops were all connected with the same line, which was a party wire. The telephone was placed in a storm-proof box with a door held shut by a padlock. A large gong was attached to the telephone and placed in a separate compartment at the bottom of the box. This compartment was open on the bottom so that the bell could be heard at a distance.

The connections to the drop wires were made by means of clamps which did away with the usual scraping of wires and wrapping with tape. The box was hung from the pole on a small railroad spike.

The telephone was carried forward as the mixer progressed and was always located so that the large gong could be heard from the mixer. It was almost invaluable in keeping in touch with the office, which was from 1 to 3 miles away. The use of the telephone prevented delays from shortage of material, getting repairs to the mixer and other causes. It paid for itself many times over.

The telephone was employed by the Granite City Lime & Cement Company, contractors for this section.

Driver Made of Farm Truck, Gas Engine and Old Mixer Drum Does Rush Job

THE ROAD DEPARTMENT of Los Angeles County, California, recently, under the necessity of carrying out rush work in protecting the banks of a stream subject to sudden floods, assembled from discarded material a driver which cut the cost of placing pipe piles by 90 per cent. Before the emergency, the banks were being protected by driving parallel rows of 2-in. pipe which served as posts to support the wire and brush bulkhead that prevented the current from cutting away the bank behind. These pipes were being driven by hand, using a heavy maul. The work advanced well enough in soft ground, but when rocky ground was encountered it was rendered more difficult, with a corresponding increase in cost and time.

When sudden high water was threatened it became

necessary to speed up the work in some way. Accordingly a 3-hp. gas engine which was on hand in the division shops was mounted on a farm trailer and connected by chain drive with a small drum taken from an old concrete mixer. Leads 16 ft. in height were built on the wagon bed with hinged supports to permit them to be lowered in transit. A 2-ft. length of 4-in. steel shafting which weighed about 125 lb. was found in the shops and was drafted for use as a hammer. The leads

were fitted for it by facing them with angle iron, the apex of the V's being set in the timber and the insides of angles forming a groove for the hammer.

At first the length of pipe to be driven was held in place by hand. Later it was found feasible to hold the pipe by strap iron guides slipped into brackets on the leads. These guides, in pairs on opposite sides of the leads, were curved to fit the pipe. They were removed each time just before the head of the

pipe being driven reached the level of the guide.

Another improvement effected after the first trial was changing the size of the cable from $\frac{1}{2}$ in. to $\frac{3}{8}$ in. The cable first tried was too stiff and the bending caused by the slack formed after each blow would break the

Don't Stop

SENDING IN your "Hints" with the idea that this section will be discontinued after the consolidation of the Engineering Record with the Engineering News on April 5.

NOT MUCH! With your help, the Engineering News-Record will keep right on publishing

HINTS FOR THE CONTRACTOR



BUILT IN 32 HOURS, IT DROVE PIPE PILES FOR 2 CENTS A FOOT

cable. A light strap-iron guide was made up by the blacksmith and fastened over the drum to prevent the cable from jumping off when the slack ran back in the line.

The cost of using the hand maul for driving the pipe was about 10 cents per foot of penetration. After the power driver was in working order the cost was cut to 1 cent per linear foot driven, and pipe was put down in rocky ground in which driving by hand would not have been feasible. Also the driver could handle pipe up to about 15 ft. long, while in driving by hand a length of 10 ft. was about the maximum.

About 325 pipes were driven, the average day's run being 60 pipes. On the best day's run 70 pieces of 2-in. iron pipe 15 ft. long were driven in the ground to an average depth of 11 ft. in 8 hours. On this day the cost of gasoline and oil used was 50 cents and the wages of three men amounted to \$7.75, a total for fuel and labor of \$8.25, or about 1 cent per linear foot of pipe driven.

All parts which were used in the makeup of this rig were available in the shop at division headquarters or were made up by the blacksmith from materials at hand. The driver was assembled and made ready for service by four workmen in about 32 hours.

The driver was first used on the Baldwin Park Division of the road work being carried out by the Los Angeles County Road Department, of which F. H. Joyner is commissioner; A. B. Smith, division engineer, and H. J. Parker, foreman.

Tap Thin Wall Form with Six-Pound Maul to Tamp Stiff Concrete

By H. S. CARPENTER
Cobleskill, N. Y.

IN CONCRETING a wall 11 in. thick a satisfactory job is being secured without using wet concrete and without tamping or spading by jarring the forms and reinforcing with a wooden mallet. In view of the letter from C. C. Howell, published in the Engineering Record of March 10, page 395, it appears that everyone is not aware that concrete of a "quaky" consistency can be placed in thin, heavily reinforced sections in this way. The hammer, a wooden mallet, should weigh about 6 lb. By striking quick, light blows with it the concrete will be caused to settle tightly against the forms and around the reinforcing.

Carry End of Chute Along High Form on Block Hung from Cable

By JAMES A. CAIN
Sistersville, W. Va.

HANGING the end of the chute from a single block running on a cable rigged above the wall forms for the new filtration plant at Sistersville, W. Va., has made it easy to move the chute frequently to avoid separation of the aggregate caused from allowing the concrete to pile up at one place in the forms for too long at a time. The outside walls of this plant are high and heavily reinforced, leaving very little room for men to spade the concrete properly. A wet mixture was therefore necessary, but it was discovered that unless the chute



BETTER DISTRIBUTION OF CONCRETE SECURED WITH SIMPLE RIG

was moved along the form every 20 minutes or so the gravel would pile up, allowing the sand, cement and water to run off. The cable shown in the photograph was therefore rigged to secure better distribution. It was 7 ft. above and parallel to the top opening of the form. The end of the chute, suspended by an adjustable chain from a block riding on the cable, could then be moved along the form at will.

The construction of the plant, which is under the direction of the writer, is being carried out by Dayton & Francis, general contractors, of New Martinsville, W. Va., under the supervision of Douglass & McKnight, engineers, of Pittsburgh, Pa.

Air Hammers Driven by Portable Compressor Calk Pipe Joints Rapidly

By C. G. CUMMINGS
New York City

IN CONSTRUCTING a 12-in. pipe line a short while ago the Burro Mountain Copper Company, Tyrone, N. M., used two small air hammers supplied by a portable gasoline-driven compressor to calk the pipe at the rate of 30 to 40 joints per day. The Sullivan compressor was belt-driven by a 8-hp. gasoline engine, the plant being mounted on skids. Two small hand drills fitted with special calking tools made on the job were used to calk 15 to 20 joints apiece daily with oakum and soft lead. The compressor remained at one place until the $\frac{3}{4}$ -in. pipe line to the drills became 500 ft. long, when the machine would be moved ahead. The large pipe was laid and calked at a rate of 400 ft. per day. The foreman stated that the progress of the work was limited by the rate at which the trench could be dug and that the two hammers could have calked 60 per cent more pipe per day if the trench in which to lay it had been ready.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Utah Ousts Power Companies from Public Lands

U. S. Supreme Court Sustains Injunction and Upholds Federal and Limited State Sovereignty

The Supreme Court of the United States, in a decision handed down March 19, has decided against the power companies in the government's suit to oust the Utah Power & Light Company and the Beaver River Power Company from public lands in the Wasatch and Fillmore forest reservations in Utah. The decision sustains the injunction in the Utah power case and upholds federal and limited State sovereignty.

The power companies, both of which are Colorado corporations, had permission from that State to develop water power in the forest reservations for public purposes. The question of State rights was therefore intimately involved, as the power companies contended in the courts that the State, and not the federal government, had the right to permit the use of public lands, even government lands, to develop public resources.

The decision settles many important questions as to possible electric-power development not only in Utah but in Nevada, California, Colorado, Idaho, and other States where there are "public lands." Some of these States intervened, claiming they had control.

The Utah courts sustained the claim of federal control, and ordered the power companies off the public domain. The attorneys general of the States where there are "public lands" claimed they had authority to develop resources for public purposes. Ownership by the federal government was conceded by these States, and ownership of the water was not directly questioned.

Engineers to Discuss Their Profession at Chicago

The welfare and future of the engineering profession will be up for discussion March 29 and 30, when the committee on engineering co-operation holds its third annual conference at 1735 Monadnock Block, Chicago. Explicit plans for the improvement of professional conditions will be proposed by its leading members, and possibly adopted by the half-hundred societies to be represented. The committee not only welcomes comments from the society representatives, but it also invites discussion from all other engineers.

The report of the subcommittee, prepared after the meeting of November, 1916, for presentation to next week's conference, is abstracted elsewhere in this issue.

Two Die When Caught by Air Suction in Dam

A strange accident which occurred at the Elephant Butte Dam, New Mexico, resulting in the death of F. O. Babcock and H. E. Reid, has been reported by A. P. Davis, director and chief engineer of the U. S. Reclamation Service.

Babcock went on duty in the power house at 4 p. m. and was to be relieved by Lewis an hour or two later. Lewis went to the power house and, not seeing Babcock, went through the dam looking for him. In the air inlet chamber of the west upper valve he found both Babcock and Reid standing with their faces to the wall, their bodies held in place by the suction of the air inlet tube. Babcock's right arm was extended into the tube as if he had been pointing out something to Reid. The latter may have approached to see better, when his overcoat and body, as well as that of Babcock's, practically closed the opening. The suction due to vacuum not only held the men fast, but exerted a pressure of some 6000 lb. on the portion of their bodies exposed to the action. To release them Lewis had first to close the valve.

Connecticut Engineers to Take War Census

At the meeting of the Connecticut Society of Civil Engineers, held recently at New Haven and attended by more than 130 registered members, papers were presented by Caleb Mills Saville, president of the New England Waterworks Association, and by J. W. Rollins, of the Holbrook, Cabot & Rollins Corporation, on deep foundations. Other speakers presented several interesting engineering topics. Telegrams were sent to President Wilson, approving his patriotic steps in connection with Germany, and to Governor Holcomb of Connecticut.

Addresses were given both by Major La Forge and Major Verrill, engineer officers of the Third District, U. S. A., on the details and formation of an Engineer Officers' Reserve Corps. The society voted to take a census of its members to have information in the hands of the secretary which would be of service in case engineering assistance should suddenly become necessary in connection with the movement of troops. The officers elected are as follows: President, Henry R. Buck, Hartford; vice-presidents, William R. Dunham, Jr., New Haven, and Charles J. Bennett, Hartford; secretary and treasurer, J. Frederick Jackson, Hartford, and assistant secretary, Robert J. Ross, Hartford.

Waterworks Men Discuss Boards of Health

Well-Pumping Costs, State Legislation and Frozen Meters Command Attention of Waterworks Men

Fewer papers and more discussions than usual were indulged in at the annual meeting of the Illinois section of the American Waterworks Association, held March 13 and 14. Deep-well pumping data of a nature hard to find, reasons for meters freezing, rigid board of health control of sanitation versus advisory control and filtration of all water supplies drawn from Lake Michigan were the main topics.

Many Middle West superintendents had much more trouble than usual with frozen meters during this past winter on account of the protracted cold weather and the small fall of snow. W. E. Lautz of Pekin reported that of the 700 meters set outside, 20 per cent were frozen, and that this was the first year that trouble had been experienced. Jay A. Craven, of the Terre Haute Water Company, reported 175 meters frozen, and an investigation did not disclose any reason except the unusually cold winter. No evidence was found to indicate that any one type of box or setting had any particular advantages and the only reason why more meters did not freeze seemed to be the large amount of water passed by them.

The Champaign & Urbana Water Company has 150 meters of its total of 5000 set at the curb. Never before have these frozen, but 10 per cent of them gave trouble this winter, due, according to F. C. Amsbary, manager, to the fact that they were set within 10 in. of the ground surface. Meters having an 18-in. cover did not freeze, nor did the risers freeze if they were kept away from the sides of the box. A member suggested the use of a felt-lined wood cover set down over the top of the meter inside of the box as an effective barrier to the frost.

Deep-Well Data

Melvin L. Enger gave detailed monthly cost figures based on sixteen months' operation of five 140-ft. wells supplying the University at Urbana. The total maintenance cost was equivalent to \$151 per year for one pump operating 15.6 hours per day or 0.82 cent per 1000 gal. pumped. Ira W. Fisk presented a study of 22 electrically driven well pumps of the Champaign & Urbana Water Company from the standpoint of proper power load on the motors. The experiments are not finished, but they indicate that smaller motors and larger flywheels would give

a more uniform and efficient load factor.

A Board of Health with Teeth

Paul Hansen, chairman of the section, in the absence of Dr. C. St. Clair Drake, secretary, State Board of Health, read the latter's paper on the "Proposed Reorganization of the Illinois State Board of Health." Mr. Hansen expressed the opinion that while it is the function of the board to exercise police powers over sanitary matters as they affect health, it should give the local authorities the widest latitude in working out their own problems. Nevertheless, there are limits beyond which the municipalities should not be allowed to go. With this view John W. Alvord took issue, holding that the state authority's field should be largely, if not wholly, advisory, as has been the work of the state water survey. He cited the cases of Massachusetts and Ohio as being states wherein arbitrary control had led more or less to an overthrow of the department. It is his idea that Americans are not a docile people, and must be led by education, not driven by arbitrary rulings. If a state department proceeds to use such power it will fast put itself out of business.

S. A. Greeley felt a central control department was essential in handling intercity problems. He cited the present typhoid epidemic in the North Shore district as an illustration. Cities and towns to the north of Winnetka, for which Mr. Greeley is alderman, have numerous typhoid cases and discharge untreated sewage into the lake. They also drink a water that is treated, if at all, by only an emergency sterilization plant. His own town under these circumstances needs filters. State water officials have used all of their advisory powers, but something stronger is needed to bring about action—some outside authority on which the local adherents of better things can hang additional arguments for expenditures for filtration works.

Chicago's Water Supply Menaced

Walter A. Shaw, of the Illinois State Public Utilities Commission, in his paper on "Water Supply as Effected by Regulation," pointed out the fact that although Chicago had spent more than \$75,000,000 for the drainage canal, its water supply was still menaced by its neighbors to the south and north. Responsibility for the regulation of water supply and sewage pollution is now divided among four state agencies. The state water survey has advisory and investigating powers; the board of health requires the submission and approval of plans; the rivers and lakes commission intends to prevent all stream and lake pollution affecting fish life and the public utility commission has already ordered two private filter plants constructed to serve their customers adequately and safely. He would put all of this overlapping and conflicting authority under one head. Further, he advocated federal control

over the states with reasonable penalties for the pollution of those streams over which the national government now has jurisdiction. After a national commission had made a scientific study, he held, it should have authority to compel the states to carry out water-supply and sewage-disposal measures, as the case might demand.

H. E. Barnard, Indiana state food and drug commissioner, in his paper on "Public Utilities and Public Health," was vigorous in his views of the necessity of making the waterworks officials recognize the importance of purveying only potable water. He deplored the fact that the fire chief's demands were too often more heeded than the admoni-

ing demands. The latest improvement is a timber trestle dam with a concrete armor facing over it. To prevent the 2 x 4-in. needles from swelling so tightly together that they cannot be removed, a strip of felt used in road expansion joints is applied at intervals of 16 ft.

The flow of water from different portions of the underground galleries of the Des Moines Water Company was determined by the continuous application of salt at the upper end, and then sampling the water at various manholes. D. H. Maxwell, assistant engineer with Alvord & Burdick, outlined the method, stating that it was used instead of current meters on account of the low velocities. The yield per foot length varied from 0.2 to 1.11 gal. per minute.

W. R. Gelston, superintendent of the Quincy waterworks, led the round-table discussion on the value and relation of laboratory control to the operation of water purification plants. His motto is: "Strive for the best efficiency consistent with safety first." He stated that 1½ hr. was necessary to collect samples, plate them, make the counts and record them. Five different samples of water are collected for plating, and duplicate agar plates are run on each sample twenty times per month.

The officers elected for the coming year are as follows: Chairman, E. MacDonald; vice-chairman, W. W. De Berard; treasurer, H. E. Keeler; new trustee, L. A. Fritze, and old trustees, F. C. Amsbary and W. E. Lautz. These compose the board of directors, and they elected Prof. Edward Bartow secretary.

J. G. Sullivan Heads Railway Engineering Association

J. G. Sullivan, chief engineer of the Western lines of the Canadian Pacific Railway, was elected president of the American Railway Engineering Association at its annual convention in Chicago this week. The awarding of the office to Canada emphasizes the absence of the international boundary line in this organization, and seems particularly happy at this time.

Although Mr. Sullivan has spent twenty years with Canadian railroads, he is not a native of Canada. He was born Jan. 11, 1863, at Bushnell's Basin in western New York, and was educated at Cornell University, being graduated in 1888. He entered railroad service the same year, starting with the Great Northern Railway as rodman. Part of 1889 and 1890 he was with the Spokane Falls Northern Railway, but returned to the Great Northern as assistant engineer, remaining until 1893. Two years with the Alberta Railway & Coal Company as assistant engineer, a short period with the Butte, Anaconda & Pacific Railway as locating engineer, and a year with Kaslo & Slocan as principal assistant engineer followed.

In 1896 he went to the Columbia & Western Railway, now a part of the

Elected President of American Railway Engineering Association



J. G. SULLIVAN

tions of the health officer. Condemnation was heaped on waterworks officials of four towns in Indiana where the use of chemicals was stopped for periods of from two days to four weeks because of negligence in failing to order chemicals on time. Such officers who jeopardized human life would not long hold their commissions in an army. Reasons for this condition, he held, are that consumers are asleep, health officials are timid, the press is indifferent and chambers of commerce are afraid of hurting business.

Filter Lake Michigan Water

Eventual filtration of all the water taken from Lake Michigan was the prediction of S. A. Greeley in his paper on "The Treatment of Supplies from Lake Michigan." In the meantime, where reliance must be placed on treatment with chlorine, expert supervision should be provided and routine analyses made at frequent intervals. H. M. Ely, superintendent of the Interstate Water Company, Danville, indicated, by lantern slides showing his own company's improvements, the ever-increas-

Canadian Pacific system, as reconnaissance engineer, and two years later became principal assistant engineer. In 1900 he was made division engineer of construction of the Canadian Pacific, holding this position until 1905. At that time he went to the Panama Canal as assistant chief engineer, but returned early in 1907 to become manager of construction of the Eastern lines of the Canadian Pacific. The next year he became assistant chief engineer, early in 1911 was assigned to the Western lines, and in October of the same year was advanced to the place he now holds.

Mr. Sullivan has been a member of the American Railway Engineering Association since 1900. He has served on the ballast and roadway committees and the committee on economics of railway location, and has been chairman of the latter committee for the last three years. He was elected a director of the society in 1913, second vice-president in 1915, and first vice-president a year later. He is also a member of the American Society of Civil Engineers and the Canadian Society of Civil Engineers.

To Hang Illinois Road Bond Issue on Auto Owners

The latest turn in the \$60,000,000 good-roads bond issue in Illinois will hang the burden mainly on the automobile owners by doubling the state license fee within three years. At a meeting of the Illinois Highway Improvement Association at Springfield, Governor F. O. Lowden indicated that he would not support a proposition to raise the money by general taxation, but he would accept a proposal to increase the license fees 50 per cent in 1918 and 50 per cent in 1920. It is estimated that the revenue produced in twenty-five years, the life of the 20-year bonds, will be \$145,000,000. This will take care of the interest and principal, and in addition leave \$63,000,000 for the state-aid fund to help the counties which would be required to put up an equal amount. The state-road system consists of approximately 16,000 miles and, in round numbers, \$200,000,000 will build the system.

The automobile associations, representing the 300,000 machines in the state, have already signified their willingness to co-operate, realizing that the yearly wear and tear on machines, due to present road conditions, is more than equal to the additional tax proposed. The proposition is to be put up to the present legislature, which can authorize an election on the bond issue in November, 1918.

New Jersey Road Board Named

The New Jersey Highway Commission of eight members was nominated last week by Governor Edge. The two engineers required by law to form a part of the board are Colonel Edwin A. Stevens, appointed for a two-year term, and Watson G. Clark, appointed for a three-year term.

All-Inclusive Engineers' License Bill Up in Iowa

After July 4 the practice of civil engineering in Iowa without a license will be a misdemeanor, carrying a fine of from \$100 to \$500, or a sentence of three months in jail, if a bill now in the hands of the Senate judiciary committee is enacted. As noted in the Engineering Record of March 3, page 365, in the report of the Iowa Engineering Society meeting, the bill provides for an examining board selected from a list furnished by the Iowa Engineering Society, a \$3,000 secretary, classification into branches, a \$10 examination fee to be renewed yearly for \$1, a \$3 fee for non-residents holding a license from their own State, and the exemption of services rendered to the U. S. Government, or to interstate carriers.

Smoke Ordinance Proposed for Denver

Proceeding on the assumption that smoke cannot be eliminated but can be materially reduced without harsh restrictions or unnecessary hardships, the committee of the Civic and Commercial Association of Denver recently submitted an ordinance to the city authorities which proposed a comprehensive system of smoke abatement for the city.

The present city ordinance dealing with smoke abatement, the committee finds, is defective and useless. In the administration of new regulations it is suggested that there be appointed a commission consisting of five members to act as an advisory body to the smoke inspector and, in a general way, to obtain the co-operation of the owners of all power or heating plants; also to establish rules for the guidance of the smoke inspector. No legal action is to be taken by the city without the sanction of this commission, which is to consist of three men actively engaged in engineering practice, one the owner or representative of substantial real-estate interests in the business district, and one an actual manufacturer. All are to serve without pay and for terms ranging from one to five years. It is proposed that the inspection department of the city shall include a deputy inspector appointed by the mayor, whose duty shall be to aid in the abatement and prevention of unnecessary smoke. Plans for new plants, or for the reconstruction of old plants producing power and heat, or for any new chimney connected therewith, must be presented for the approval of the smoke inspector.

The emission of smoke of a density in excess of 40 per cent, or equivalent to No. 2 of the Ringlemann scale of smoke densities, from any plant, locomotive or contrivance, is prohibited and declared to be a violation of the ordinance. An exception is made, allowing a period of 15 minutes in any one hour for cleaning fire boxes or building new fires.

It is required that all existing heating or power plants, in which 90,000

cu. ft. of air is heated by the same plant, shall register with the smoke inspector the name and address of the owner, together with size or manufacturer's rating of the boiler. Any person violating any of the provisions of the ordinance is liable to a fine of not more than \$100 for each offense.

The committee consists of Frank E. Shepard, W. W. Case, Jr., C. S. Pearse, Henry Read, and Lewis C. Skinner.

Prize Winners in Housing Competition Announced

Prize winners in the national housing competition inaugurated by the National Americanization Committee in the spring of 1916 have been announced, and the prize-winning plans published in the January issue of *The Architectural Review*. The object of the competition was to produce good and economical plans for low-cost dwellings to be used as standard types, in this manner directing the attention of manufacturers, property owners and municipalities to the importance of industrial housing and providing definite solutions for particular housing problems.

The various classes in which prizes were awarded, and the prize winners, are as follows: First prize, four-room, single-family house design, by William Lyon Summerville and Atwell J. King, associated; second prize, five-room, single-family house design, by J. Theodore Hanemann; first prize, six-room, single-family house design, with two rooms arranged for four boarders, by William Lyon Summerville (Atwell J. King associated); second prize, by John Ambrose Thompson and Ernest F. Lewis; first prize, boarding-house design, by Harry E. Warren; second prize, by E. F. Strassle.

Copies of the prize-winning designs can be obtained from the National Americanization Committee, 29 West Thirty-ninth Street, New York City, or from *The Architectural Review*, 144 Congress Street, Boston.

Alumni of Stevens Tech Organize

During the past year the alumni of Stevens Institute of Technology have been compiling a classified list of Stevens men who are willing and ready to serve in such branches of the Army or Navy for which their education and experience would best fit them. The enrollment is being carried on under the auspices of an advisory committee, of which Alex C. Humphreys, president of Stevens Institute of Technology, is chairman.

Seattle, Wash., Rejects Bond Issues

Seattle, Wash., has rejected by an overwhelming majority all bond issues submitted March 6. The defeated issues provided for the following items: \$270,000 for Montlake bridge over the Lake Washington government canal, \$450,000 for highway improvement,

Southern Railway System Replaces Frame Trestles

To facilitate the movement of the very heavy traffic which passes over the line between Morristown, Tenn., and Salisbury, N. C., the Southern system plans to put in service Santa Fe type freight locomotives, which are much heavier than the ones now in use, and which make it necessary to replace every frame trestle on 228 miles of the line by permanent structures of steel and concrete. This work has been in progress for several months.

The extent of the work will be understood from the fact that it includes the erection of 18 new steel bridges to take the place of lighter structures, enclosing 5 stone and brick arches in reinforced concrete, the elimination of 119 trestles by construction of 6 underpasses for highways and 14 concrete culverts, and the earth filling of the remaining trestle construction. Large concrete and cast-iron pipes will be placed to take care of drainage.

Over the section being remodeled a large volume of coal is handled from Virginia and Tennessee mines, and a heavy miscellaneous traffic in both directions. The section between Morristown and Asheville carries the heaviest traffic, and includes the recently inaugurated movement of Southern coal for export through the port of Charleston.

Southern Pacific Arranges for New Western Terminal

Following a meeting held recently in San Francisco between city officials and E. B. Leavitt, assistant general manager of the Southern Pacific Railroad, to arrange for the transfer of a site for a rail-and-water terminal, a resolution was adopted by the Board of Supervisors directing the city attorney to arrange for the transfer of city property in China Basin, which the railroad company desires for terminals, in exchange for property owned by the company at the foot of Van Ness Avenue. The city is also to receive from the company \$392,073 in cash, which represents the difference between the appraised value of the two properties. The city lands to be transferred to the company were appraised at \$818,768.

China Basin is an arm of San Francisco Bay, about 2 miles south of the foot of Market Street, located near the present Third and Townsend streets depot of the railroad company. By improving the channel in the basin and erecting suitable structures, industrial sites will be provided with rail and water connections for manufacturing establishments.

Idaho to Prohibit Narrow Tires

A bill recently passing the lower house of the Idaho legislature prohibits the sale of wagons having tires less than 3 in. in width, and makes it a misdemeanor to go outside the state to purchase such wagons. The act calls for enforcement after Jan. 1, 1919.

What Engineers and Contractors Are Doing

W. M. BUTTS has severed his connection as assistant division engineer of the Huntsville division of the Nashville, Chattanooga & St. Louis Railway, and has returned to the Pacific Coast.

CHRISTOPHER HARRISON, who has been city engineer of Everett, Mass., for the last twenty years, has resigned and will become city engineer of Montclair, N. J., on April 1.

HOWARD F. WEISS has resigned his position as director of the U. S. Forest Products Laboratory, Madison, Wis., to engage in the development of products and processes for the profitable utilization of wood and timber with the C. F. Burgess Chemical Engineering Laboratories, Madison. As director of the U. S. Forest Products Laboratory, Mr. Weiss, while devoting his time to the study of wood, had charge of numerous investigations in kiln drying, wood preservation, wood distillation, pulp and paper manufacture, mechanical testing of timber, production of ethyl alcohol, turpentine and other wood products in the United States, Canada, Cuba and South America. He is a graduate of both Yale and Cornell universities, and entered the forest service twelve years ago. He is author of the book, "Preservation of Structural Timber."

H. C. CORNS and C. C. THOMAS have formed the Corns-Thomas Engineering & Contracting Company, Inc., with offices in the First National Bank Building, Huntington, W. Va. Mr. Corns has had twenty years' experience on river and harbor, municipal and private work. Until recently Mr. Thomas was manager of the Wetzel Engineering Company.

J. M. WEIR has been appointed chief engineer by the Kansas City Southern Railway, with headquarters in Kansas City, Mo. Mr. Weir entered the employ of the railroad in June, 1916, as division engineer.

J. MONROE JOHNSON, of Marion, S. C., has been appointed a member of the State Highway Commission created recently by the general assembly. Mr. Johnson has been connected with the state reclamation and drainage work. He organized the Johnson Engineers' Corps of the South Carolina National Guard.

P. W. LOONAM, county surveyor, St. Charles County, Missouri, has been appointed county highway engineer to succeed Alfred Riske.

HARLEY O. MARQUIS, Monon, Ind., has been appointed chief engineer of the city water works, succeeding John G. Hill.

JOHN C. HITESHEW, Carlisle, Pa., has been appointed borough engineer at Waynesboro, succeeding George C. Brehm, resigned.

H. Y. SMITH, for the last ten years with the Atlantic Construction & Supply Company, Atlantic City, N. J., is now associated with the Wisconsin Tunnel & Construction Company, Milwaukee, Wis., as its engineer-superintendent in charge of sewer tunnels and open-cut work in Milwaukee, estimated to cost \$700,000.

J. C. HOLLAND, for several years designer and estimator for the Illinois Steel Company, warehouse department, is engaged as chief draftsman for the St. Joseph Structural Steel Company at St. Joseph, Mo. Mr. Holland is a graduate of the University of Minnesota, 1904, and has been located in the Chicago district since 1905.

STANLEY E. BATES, formerly editor and manager of *The Contractor*, has become associated with the Lee Loader & Body Company, South La Salle Street, Chicago. Mr. Bates has made a special study of haulage problems, particularly those of the contractor, and is author of many articles on the subject. His new duties will be in charge of the sales department.

A. L. STRONG, until last February county engineer of Skagit County, at Mount Vernon, Wash., has joined the forces of the Skagit Valley Construction Company of that city.

CHARLES W. MARTIN, engineer, of St. Louis, Mo., has become a member of the Woermann Construction Company of that city. Mr. Martin has been a member of the bridge department of St. Louis for the last seven years.

J. A. MACKALL, Baltimore, Md., has been appointed an assistant to the chief engineer of the Pennsylvania State Highway Department.

EVERETT L. JONES, for six years chief engineer for Booth & Flinn, Ltd., general contractors, of Pittsburgh, Pa., has resigned to become general superintendent and chief engineer of the Pittsburgh-Hanover Coal Company, with offices in the Vandergrift Building.

S. CAMDEN MILLER has accepted the position of general manager with the Mesker Brothers Iron Company, of St. Louis, Mo. Mr. Miller was formerly operating engineer of the Canton Bridge Company, of Canton, Ohio.

A. H. JONES has been appointed assistant engineer on street-railway matters, Bureau of Engineering, by the Public Service Commission of Harrisburg, Pa. For the last seven years Mr. Jones has been with the Public Service Railway of Newark, N. J., under the engineer of maintenance of way, in the capacity of engineer, roadmaster and division engineer.

L. H. NISHKIAN has been reappointed structural engineer of the building-permit department of the city of San Francisco. Political reasons were ascribed for Mr. Nishkian's removal from this office last year, at which time the San Francisco Association of Members of the American So-

ciety of Civil Engineers adopted a resolution regretting his removal and expressing "confidence in the impartial, trustworthy, fearless and competent manner in which he has conducted work in his office." The reappointment came after Mr. Nishkian passed a competitive examination for the office.

CARL H. REEVES, consulting civil engineer, Seattle, secretary-treasurer of the Seattle Association of Members of the American Society of Civil Engineers; John L. Hall, consulting engineer, president of the Associated Engineering Societies of Seattle, and Amos Slater, mining engineer, acting secretary-treasurer of the Associated Engineering Societies of Seattle, have become associated in business and will hereafter have their offices at 445-46 Henry Building.

WILLIAM H. CORDRY, formerly with the W. J. Sherman Company, Toledo, Ohio, on dam construction, and at one time assistant engineer, Baltimore Sewerage Commission, has joined the staff of Gannett, Seelye & Fleming as assistant engineer in connection with the Mill Creek flood control and Erie sewage-treatment investigation. He is a graduate of Lehigh University, class of 1911.

C. A. JENNINGS has been put in charge of the new Chicago office opened by the Wallace & Tiernan Company, Inc., manufacturers of chlorine-control apparatus. Mr. Jennings was formerly engaged on work in connection with the Bubbly Creek filters of the Union Stock Yards in Chicago, and has done considerable research in the field of water purification, particularly along the lines of chlorination. H. K. Davies will be transferred from the New York office of the company to Chicago as assistant engineer to Mr. Jennings. J. C. Kaebler has been appointed to the technical staff of the company as assistant engineer. He is a graduate of the University of Rochester and was formerly connected with the Western Electric Company. R. V. Donnelly has been made assistant sanitary engineer. Mr. Donnelly is a graduate of Columbia University and was for a time with the New York Continental Jewell Filtration Company.

ALBERT R. BAILEY, assistant professor of civil engineering, University of Michigan, has been granted a leave of absence for the remainder of the college year to accept a position with F. W. Stevens, general valuation counsel for the New York City Railroad. He will be located in New York City after March 19.

ROYALL D. BRADBURY, consulting engineer, Boston, Mass., has closed his office and has become manager of the newly created structural department of the Clinton Wire Cloth Company, Boston, Mass. Mr. Bradbury has for about eight years been acting as consulting engineer of the Clinton Wire Cloth Company, meanwhile carrying on a general consulting engineering practice, chiefly in structural lines. He was for seven years a member of the

instructional staff of the Massachusetts Institute of Technology, teaching courses in bridge design, theory of structures and reinforced concrete. As consulting engineer for the Clinton Wire Cloth Company he has advised on tests of new products and types of construction, has directed extensive investigations and, in general, assisted the company in perfecting its structural products.

RAYMOND DUPUY, who has resigned as president of the Virginian Railway, with headquarters at Norfolk, Va., was assistant engineer on the Missouri, Kansas & Texas Lines from 1878 to 1881, and was chief engineer and superintendent of the Tioga Railway, now a part of the Erie Railroad, from 1881 to 1885.

W. K. WALKER, assistant engineer on the Wabash Railroad at Fort Wayne, Ind., has been appointed engineer maintenance of way, with headquarters at Montpelier, Ohio.

THOMAS BERNARD, assistant to the chief engineer, maintenance of way and structures, of the Southern Railway, with headquarters at Greensboro, N. C., has been appointed engineer of surveys, with headquarters at Washington, D. C. He has been in the continuous employ of this road since 1882, since which time he has served as assistant engineer, roadmaster, superintendent of tracks, bridges and buildings, engineer maintenance of way and assistant to the chief engineer maintenance of way and structures.

WENDELL P. BALL, assistant engineer of track construction on the Cincinnati, Hamilton & Dayton Railway, has been appointed to the newly created position of district bridge inspector.

PAUL B. LUM, assistant engineer of the Southern Railway at Washington, D. C., has been appointed to the newly created position of structural engineer, where he is in charge of structural work in the office of T. H. Gatlin, assistant to the vice-president at Washington, D. C. Mr. Lum entered railway service with the Lake Shore & Michigan Southern Railway, and subsequently was employed by the American Bridge Company at its Pencoyd plant. He entered the employ of the Southern Railway as an assistant engineer in 1908.

M. J. CONNERTON, roadmaster of the Queen & Crescent Route at Danville, Ky., has been appointed engineer maintenance of way of the southwest district of the Southern Railway, lines West, with headquarters at Chattanooga, Tenn.

M. P. NORTHAM, office engineer of the Southern Railway at Washington, D. C., has been appointed supervising engineer, with headquarters at the same point.

O. L. VANDAMENT, assistant division engineer of the Louisville & Nashville Railway, with headquarters at Louisville, Ky., has been transferred to the office of the chief engineer, suc-

ceeding J. C. Haskins, who has resigned to go with the Roberts & Schaefer Company, Chicago. J. E. Scott, assistant division engineer, with headquarters at Montgomery, Ala., has been transferred to Louisville, to succeed Mr. Vandament.

S. A. JUBB, engineer in charge of the harbor work at Los Angeles, Cal., has been authorized by the harbor commission of that city to go to Washington, D. C., in the interests of extensions of Los Angeles harbor facilities. Mr. Jubb is instructed to take up with government officials plans for a submarine base in the outer harbor, the question of widening the harbor's main channel to 1000 ft. and of having a survey made of the west basin relative to needed dredging.

H. S. SLOCUM, who has lately been engaged on the Laurentide hydroelectric development at Grand Mere, Province of Quebec, Canada, has entered the engineering department of the Aluminum Company of America, as engineer in charge of construction, and will be located at Potsdam, N. Y. Mr. Slocum has had extensive experience in the design and construction of hydroelectric plants. For six years he was with the Niagara Falls Power Company, and then went with Viele, Blackwell & Buck, working on the Great Western and the Appalachian power developments. Terminating his connection with Viele, Blackwell & Buck, he became mechanical engineer for the Cedar Rapids plant of the Cedar Rapids Manufacturing & Power Company, and then was engineer in charge for the Northern New York Power Corporation. From there he went to Grand Mere.

Civil Service Examinations

United States.—Structural-steel draftsman, Bureau of Yards and Docks, Navy Department, \$3.04 to \$8 per diem. Applications will be received at any time, owing to unusual conditions, and papers will be rated immediately upon their receipt. Apply to U. S. Civil Service Commission, Washington, D. C., for form No. 1312, or to any local office of the commission. Assistant inspector of engineering material, April 18, \$4 to \$4.48 per diem; apply at once for form No. 1312. Senior land appraiser, April 18, \$1,800 to \$2,700 per year; apply at once for form No. 1312.

California.—Engineering draftsman, Grade I and Grade II, April 6 and 7, \$50 to \$100, and \$100 to \$150 per month; apply to California Civil Service Commission, Forum Building, Sacramento, for form No. 2, and file before March 31. Civil engineer, April 13 and 14, \$100 to \$150; apply as above, and file before April 7. Engineering assistant, April 7, \$50 to \$100; apply as above and file before March 31.

Illinois.—Transportation rate expert, April 7, \$416.66 to \$500 per month; applicant must be over 26 years old; apply to Illinois Civil Service Commission, Springfield, Ill., for blank, and file before March 31.

Obituary Notes

ALFRED W. PARKER, one of the best known structural steel inspecting engineers in New England, died recently at his home in Waltham, Mass., in his seventy-third year. He was a native of Providence, R. I., and after receiving a public school education was employed from 1863 to 1868 by J. R. Robinson & Company, Boston, constructors of steam plants in New England mills. From 1868 to 1876 he was superintendent of shops, National Bridge & Iron Works, Boston, and in 1877 was associated with Captain J. B. Eads in laying out and building a steel dredge boat at Pittsburgh, Pa. Following this work he superintended the steel erection on the Ninth and Second Avenue elevated lines in New York City for Clark, Reeves & Company, Phoenixville, Pa. From 1880 to 1895 Mr. Parker was with the Boston Bridge Works, and from 1895 to 1899 he was chief inspector of steel work for the Boston Transit Commission. He then spent four years as chief inspector of steel work for the Boston Elevated Railway, and from 1902 until his death was superintendent of steel work for the Boston Transit Commission.

GEORGE H. FROST, seventy-nine years old, founder and for many years publisher of the *Engineering News*, died March 15 at Plainfield, N. J. He was born in Ontario, and in 1860 was graduated from McGill University as civil engineer. He engaged in land surveying, and for several years was connected with the Chicago & Northwestern Railroad, laying the first mile of track west of Chicago. He founded the *Engineering News* in 1874, and published it until 1911. He was president of the Courier News Publishing Company of Plainfield, N. J., and a member of the American and Canadian societies of civil engineers and honorary member of engineering societies in several States.

PETER SIEMS of St. Paul, Minn., pioneer transportation and railway contractor, builder of the portion of the Great Northern Railway extending from Devils Lake, N. D., to the Pacific Coast, associate of the late James J. Hill, died at Daytona, Fla., March 3. Born in Germany in 1842, he came to the United States in 1865 and moved to St. Paul in 1870. His first transportation contract was carrying the mails overland from Fargo to Bismarck, Dakota Territory, in 1875. In 1884, after several years in stage operation and highway location in the gold country, he returned to St. Paul and entered the railway contracting business as a partner in D. C. Shepard & Company. Later, as Shepard, Siems & Co., the firm built many thousands of miles of railroad in the Northwest, including the Great Northern line to the Pacific in 1893. In 1889 the firm became Siems & Shields, and in 1908 it was reorgan-

ized as Siems & Co. Meanwhile Mr. Siems withdrew from active participation in the business, and six years ago, through affiliation with F. W. Carey, the concern again was reorganized and became the Siems-Carey Company. The Siems-Carey Company recently obtained a \$100,000,000 contract for railway construction in China.

FERDINAND W. ROEBLING, treasurer and general manager of J. A. Roebling's Sons & Co., builders of the Brooklyn Bridge and other noted bridges, widely known in the wire rope industry, and director in a dozen or more other big companies, died March 16 at his home in Trenton, N. J. Mr. Roebling, who was seventy-five years old and the son of John A. Roebling, founder of the noted construction firm, was born in Saxtonburg, Pa. He was educated in Polytechnic College, Philadelphia, and after graduation entered into business with his father. In 1869 his father was fatally injured in an

Head of Wire Rope Company Dies



FERDINAND W. ROEBLING

accident while making soundings for the foundation of the Brooklyn Bridge, which he designed. The interrupted work of the father was taken up and finished in 1883 at a cost of \$10,000,000 by Washington A. Roebling, the older son, and by Ferdinand. Mr. Roebling was a director in many concerns, among them the Interstate Railways Company, the Otis Elevator Company, the Public Service Corporation of New Jersey and the Trenton Street Railway Company. He was president of the Trenton Brass & Machine Company and the Union Mills Paper Manufacturing Company. He was a member of the Union League and Engineers' Club.

MAJOR CASSIUS E. GILLETTE, consulting engineer, prominent as an investigator, in which capacity he disclosed fraud on jetty

work at Savannah, Ga., died March 18 at his home in Philadelphia. Major Gillette's most recent activity was investigating mines in Colorado. The illness which resulted in his death became serious while he was in Colorado, and he was forced to return home. He was born in Tonawanda, N. Y., in 1859, and after receiving a common school education in Tioga County received an appointment to West Point, from which he was graduated in 1884. He was assigned to the Engineer Corps, U. S. Army, and his service included a station in Ohio for five years on lock and canal work, a year in Savannah, Ga., four years in California and six months in Newport. He also saw service on the Isthmus of Panama and later went to Philadelphia as chairman of the commission of expert engineers which investigated work in connection with the filtration plant and boulevards. It was not long before he was offered the position of chief of the Bureau of Filtration at Philadelphia. In order to accept the position it was necessary for him to resign from the army. He resigned from the filtration bureau after the filter plant was completed and entered private practice.

DANIEL WHEELER BOWMAN, consulting engineer for the Phoenix Iron Company, Phoenixville, Pa., died March 13. He was born in New Bedford, Mass., in 1844 and was a graduate of Cornell University. His first work was with Captain James B. Eads on the control work at the mouth of the Mississippi River, directly under Elmer L. Corthell, late president of the American Society of Civil Engineers. In 1876 he became connected with Clark, Reeves & Co., now the Phoenix Bridge Company, and was engaged on the design of important structures then contemplated in New York City. He resigned from that position in 1885 to go to Florida on the inspection of bridges for the Southern Railway System. For a short time he was connected with the Boston Bridge Works, but in 1894 returned to the engineering office of the Phoenix Iron Company. About 1896 Mr. Bowman resigned from the Phoenix Iron Company, and engaged in structural fabrication in Chicago. He again returned to the Phoenix Iron Company in 1898, under H. H. Quimby, chief engineer, whom he succeeded in 1900. In 1914 he resigned his position, and was made consulting engineer.

R. J. GILLESPIE, vice-president of the T. A. Gillespie Company, contractor, of New York and Pittsburgh, died March 20 of pneumonia at his home in Pittsburgh. Mr. Gillespie had been in the continuous service of the company for about twenty-five years and acted as construction superintendent on many important contracts, among them a hydroelectric plant at Whitney, N. C., the Rondout siphon tunnel of the Catskill Aqueduct and the deep pressure tunnel of the Catskill Aqueduct crossing the Hudson River at Cornwall, N. Y. For the last two years Mr. Gillespie had been stationed in the vicinity of Pittsburgh on miscellaneous contracts of the company.

Railway Strike Averted, War Imminent

Price Advances May Continue—Car Shortage Improving—Bond Market Less Active and Fewer New Securities Issued

WITH the threatened railway strike averted and the country on the verge of being drawn into the war, it is becoming evident that, while there may be no immediate effect on the construction program for 1917, less money may be available for such work, and higher prices may prevail. Partly as a result of the international situation, making it likely that a large amount of money would be required by the Government, listings and issues of new securities for the first two months of the year have already shown large declines from the figures for 1916. As has been noted previously by this journal, factors were already at work to make a less active market than that of last year for public improvement bonds.

Extraordinary work is being done by the railroads to relieve the car shortage, and doubtless scattered price advances due to local shortages of construction materials will soon be checked. The lumber industry is still severely handicapped in shipping products which must be loaded in box cars, though open cars for moving the grades of timber required on heavy construction work are becoming more plentiful. As to whether further price advances will be checked by the entry of this country into the war, it would be difficult to say at present. While construction might be checked on local improvements, it is liable to receive an impetus in the transportation and industrial fields. Although it is likely that a restriction of profits on materials furnished to the Government would prevent further increase in the cost of production, the withdrawal from the market of large quantities of goods and materials to supply Government wants might cause shortages which would result in further price increases to the public. Lumber and steel would be the principal construction materials most likely to be affected in this way, and it certainly seems unlikely that steel prices will decline. Indeed, notable advances, especially in materials for ship construction, have already taken place in the present month. It might be expected also that if this country should decide to take an active part in the war, the labor situation would be adversely affected before the close of the present construction season.

Waterworks and Sewers

Bids have been received at Madison, Ill., for constructing a sewer system to cost \$170,000. Greenwich, Ohio, will

receive bids April 10 for constructing a pumping station and intake and enlarging its reservoir. A contract will soon be awarded for constructing a \$100,000 reservoir at Nazareth, Pa. The construction of \$3,500,000 sewage disposal plant for the Chicago stock yards has been recommended. New bids are to be asked for sewer construction costing \$160,000 at Grand Rapids, Mich. An expenditure of \$8,500,000 for extending the sewer and water systems at Detroit has been recommended. Engineers have been retained to prepare plans and supervise the construction of sewer and water extensions for Globe, Ariz., to cost \$750,000.

Buildings

Building construction noted in this issue includes the following items:

Contract awarded:	Kind	Cost
Jacksonville, Fla.	Railway station	\$750,000
Proposed work:		
Newport News, Va.	Shipbuilding plant	2,500,000
New York, N. Y.	Apartment	300,000
Dallas, Tex.	Bank building	800,000
Port Arthur, Tex.	Lighting plant	400,000
Long Beach, Cal.	City hall	300,000

Roads and Paving

Bids are desired in New York state at Fairmont, W. Va., for a large amount of highway work. In addition, the following highway and paving work is noted this week:

Contracts awarded:	Kind	Cost
Baltimore, Md.	Concrete	\$128,000
Lake Charles, La.	Gravel	125,000
Bids opened:		
Brooklyn, N. Y.	Asphalt	148,000
Douglas, Ariz.	Bituminous	320,000
Proposed work:		
Gaffney, S. C.	Bonds voted	225,000
Thomasville, Ga.	Paving	200,000
Mountain City, Tenn.	Bonds voted	200,000
Indianola, Miss.	Bonds sold	200,000
Greenville, Miss.	Concrete	950,000

Miscellaneous Headings

The Government contract for dredging and rock-removal in the Hudson River, New York harbor, has been awarded at \$358,000. A low bid of \$220,000 was received for lock gates to be constructed for the Government near Detroit. An additional city pier under consideration at Philadelphia would cost \$400,000. Harbor improvements amounting to \$2,000,000 are contemplated at Savannah, Ga. The construction of ore docks to cost \$5,000,000 is contemplated at Conneaut, Ohio. A transmission line which will cost \$300,000 is being surveyed near Salt Lake City, Utah. Permits have been applied for in California to construct two irrigation projects, one to cost \$450,000 and the other to cost \$300,000.

CONTRACTING NEWS

Of Special Interest to Engineers, Contractors, Builders and Manufacturers of Engineering and Building Supplies

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

WATERWORKS AND SEWERAGE SYSTEMS

PROPOSED WORK

Cohoes, N. Y.—City Council decided to construct sewer on portions of Saratoga and Niver Sts.; cost to be divided between City and property owners concerned.

Gouverneur, N. Y.—Reported a movement on foot looking to construction of municipal sewer system.

Kingston, N. Y.—Bd. Water Comrs. considering installation of large capacity filters at filter house to cost \$30,000.

Paterson, N. J.—Public Service Corporation will lay conduits in Passaic Ave. at a cost of \$15,000.

Paulsboro, N. J.—Remington & Vosbury, engr., 6th and Market Sts., Camden, preparing plans for sanitary sewer system and treatment works.

Catawissa, Pa.—Boro. Council considering construction of sewage disposal plant.

Lebanon, Pa.—City planning construction of storm sewers.

Nazareth, Pa.—Frank Huth, secy., Blue Mountain Con. Water Co., Nazareth, writes contracts will soon be let for construction of 200,000,000-gal. reservoir; cost \$100,000. Farley Gannett, engr., Tele. Bldg., Harrisburg.

Philadelphia, Pa.—Common Council planning for appropriation of \$100,000 for water

dept. for purchase of equipment for water system. Carleton E. Davis, ch. of water bureau.

Hagerstown, Md.—Reported City considering \$140,000 bond issue to be used for sewer construction.

Huntington, W. Va.—Mayor E. Sehon reports city has decided to construct 9th St. trunk sewer; cost, about \$75,000.

Gadsden, Ala.—City considering sewer extensions; cost \$25,000. E. Smith, city engr.

Crowley, La.—Reported City Council has rejected bids for sewer and will readvertise; estimated cost \$30,000.

Jackson, Tenn.—Bonds for \$40,000 voted to be used for sewer construction.

Rockwood, Tenn.—Reported City considering \$50,000 bond issue for sewer construction.

Bellevue, O.—W. J. Sherman & Co., Toledo, preparing plans and estimates for constructing reservoir; cost about \$90,000.

Bluffton, O.—Bonds for \$35,000 voted to be used for improvement of waterworks and light plant.

Canton, O.—Waterworks bonds for \$77,000 will be sold April 9, by Samuel E. Barr, city aud.

Hamilton, O.—Plans being prepared for Hancock Ave. sewer. F. E. Weaver, city engr.

Youngstown, O.—Ed. L. MacLean, mgr. eng. dept., writes construction of sewers in portions of Manhattan and Indianola Aves., Carlyle, Campbell, Smithfield Sts., Osborn, Dunlap and Manhattan Aves. and Shady Run Dist. sewers contemplated; also paving in Princeton, Audubon, Madison Aves., Center St., sidewalks and cross walks for year. Harry Parrock, dir. sew.

Youngstown, O.—Reported City considering construction of sewers in portions of Osbourne and Dunlap Aves. F. M. Lillie, city engr.

Garrett, Ind.—Baltimore & Ohio RR. Co. (R. N. Begien, ch. engr., Baltimore, Md.) reported to have decided to construct water treatment plant; cost \$22,000.

Detroit, Mich.—C. H. Hubbell, city engr., recommends an expenditure of \$3,500,000 for sewer and water extensions.

Grand Rapids, Mich.—New bids will soon be received by Bd. Pub. Wks. for construction of southwest sewer system; cost estimated at \$10,000,000.

Chicago, Ill.—Langdon Pierce, representing sanitary district, and Dr. Richardson, representing the packing interests, completed report and recommended construction of a great stock yards sewage disposal plant to cost \$3,500,000.

Harrisburg, Ill.—Reported City considering sewer improvements; cost about \$44,695. J. Upchurch, city engr.

Lombard, Ill.—Reported about 12 mi. reinforced concrete pipe sewers for all sizes above 24 in. and sewage disposal plant; cost \$165,000. W. S. Shields, engr., Hartford Bldg., Chicago.

Early, Ia.—Plans being prepared by E. T. Archer & Co., 512 New England Bldg., Kansas City, Mo., for construction of sewer system; cost \$25,000.

Montezuma, Ia.—Bond issue for \$50,000 to be used for waterworks improvements carried at last election.

Murray, Ia.—Reported plans being prepared for waterworks and sewer system; cost \$50,000. E. T. Archer & Co., engr., 512 New England Bldg., Kansas City, Mo. R. J. Badger, mayor.

Hamline, Minn.—Bill introduced in Legislature asking for appropriation of \$11,000 to be used in connecting sewerage system of State Fair Grounds with large trunk sewer just constructed by St. Paul, and \$2,000 for water main connections. Ray P. Speer, publicity mgr., Minn. State Fair.

Wadena, Minn.—Bond issue for \$14,000 carried, to be used for waterworks extensions. L. P. Zimmerman, engr., Wadena.

Baldwin, Kan.—City will vote on question of issuing \$20,000 bonds to be used for reconstruction of electric and water plant, including a filter.

Pittsburg, Kan.—Contract will soon be let to lay 2100 ft. of 8-in. lateral sewers. L. E. Curfman, city engr.

Wellington, Kan.—Reported City considering sewage disposal plant; cost about \$20,000. J. W. Mairty, city engr.

Yates Center, Kan.—Reported election will be held Apr. 3 on question of issuing \$80,000 bonds for waterworks improvements. J. W. Despeu, city clk.

Blair, Neb.—Reported City will call election April 3 on question of issuing \$20,847 bonds for sewer system.

Fremont, Neb.—City Light and Waterworks Dept. preparing plans for laying 152,970 ft. of from 4 to 12-in. c. i. water pipe.

Cooperstown, N. D.—T. R. Atkinson, city engr., of Bismark, has submitted his report for proposed water and sewer system here; cost \$40,000.

La Moure, N. D.—Reported election will be held Apr. 2 on question of issuing \$10,000 bonds for waterworks system.

Hagerstown, Md.—Sewerage Comm. requested another bond issue of \$140,000 for sewer improvements.

Joplin, Mo.—Ordinance passed by City Comm. providing for construction of 2 new sewer districts known as North Joplin No. 3 and Picher Ave. No. 1.

Austin, Tex.—Reported City considering bond issue for construction of sewage disposal plant and sewer system. Plans prepared by Hering & Gregory, engr., 170 Broadway, New York.

Corsicana, Tex.—Reported movement on foot to vote \$50,000 bonds for construction of waterworks.

Kerens, Tex.—Kerens Sewer Co. incorporated with capital of \$10,000; incorporators W. S. Price, B. S. Brown and others of Kerens.

Longview, Tex.—H. N. Roberts completed plans for \$15,000 sewage disposal plant, to be located near the city.

Bixby, Okla.—Election will be held April 3 to vote \$25,000 bonds to be used for waterworks. Robert English, pres. bd.

Coyle, Okla.—Reported City voted \$13,000 bonds to be used for waterworks improvements.

Red Rock, Okla.—Ordinance passed authorizing \$22,000 bond issue for construction of waterworks. J. M. Mitchell, town clk.

Colorado Springs, Colo.—Reported election will be held April 3 on question of issuing \$150,000 bonds to be used for waterworks improvements. B. E. Reynolds, supt.

Florence, Colo.—Reported City will hold election April 3 on question of issuing \$45,000 bonds to be used for waterworks improvements. D. H. Houston, supt.

Pueblo, Colo.—City council considering ordinance for storm sewer district on south side; estimated cost \$135,000.

Raymond, Wash.—City Council and Silver Mill Co. plan construction of concrete reservoir 1,250,000 gal. capacity; cost about \$10,000.

Seattle, Wash.—A. H. Dimock, city engr., prepared plans for constructing water mains in Alki Ave.; cost about \$122,000; also for construction of sewers in E. 54th and other streets; cost about \$46,397.

Tacoma, Wash.—Council authorized light and water dept. to install water mains as follows: 60-in. wood stave pipe on Palmer Junction Trestle, \$7,500; 22-in. wood stave pipe from So. 12th St. to Fletcher Heights, \$6,500; 16-in. c. i. pipe at J St. standpipe, \$1,500; 16-in. wood pipe at So. 54th St. and J St., \$7,500.

Chico, Cal.—B. H. Steffen purchased the water system of J. A. McFeeley west of the Esplanade, and will erect 80-ft. tower and otherwise improve and enlarge the system.

Baldwin Park, Cal.—Baldwin Park Domestic Water Co. (S. M. Walker, mgr.) plans spending \$54,000 for waterworks improvements and extensions.

Berkeley, Cal.—Reported City will call election in April to vote \$2,000,000 bonds for waterworks.

Stockton, Cal.—Plans completed and contracts will soon be let for 13,020 ft. redwood stave pipe for outfall sewers from the 2 pumping plants to be constructed to the San Joaquin River; cost about \$5,622.

Globe, Ariz.—City retained Benham Eng. Co., Colcor Bldg., Oklahoma City, to prepare plans and supervise construction of sanitary, storm and lateral sewers, waterworks extensions and street paving; cost about \$750,000. Election will soon be called to vote bonds.

Ogden, Utah.—Election will be held on question of issuing \$200,000 bonds to be used for construction of 3d Ward sewer system. Joseph M. Tracy, city engr.

Montreal South, Que.—M. M. Condon will call for tenders in April for new waterworks; cost \$180,000. E. Drinkwater, engr., 588 Biv. Des Saulniers, St. Lambert, Que.

Islington, Ont.—James Loudon and Hertzberg, engr., Excelsior Life Bldg., Toronto, have plans for waterworks, including pumps, filters, tank and 3 miles of mains; cost \$82,000.

London, Ont.—Utilities Comm. (E. V. Buchanan, gen. mgr.) will spend \$47,000 connecting up new supply wells to augment waterworks; wooden conduits will be used.

Long Branch, Ont.—James Loudon & Hertzberg, engr., Excelsior Life Bldg., Toronto, preparing plans for waterworks, including meters, standpipe and 5 miles of mains; cost about \$67,000.

Winnipeg, Man.—W. G. Chace, engr., 501 Tribune Bldg., will call for contracts in April for c. i. water mains in connection with new system.

BIDS DESIRED

Boston, Mass.—Until Mar. 27 (separate bids), by Edward F. Murphy, comr. pub. wks., for constructing pipe sewers and drains in portions of North Beacon St., Brighton, Bakersfield St., Dorchester, and Hyde Park Ave., Hyde Park.

Clifton Heights, Pa.—Until April 5, by Henry J. Sharkey, secy. boro. council, for laying terra-cotta pipe sewers. A. Y. Damon, Jr., Darby, Pa., boro. engr.

Lyndhurst, N. J.—Until April 2 (separate bids) by Bd. Comrs. (John F. Woods, tp. clk.) for laying water mains on Newark and Swayne Aves., also for furnishing 480 lin. ft. of 4 to 6-in. bell and spigot c. i. water pipe and c. i. fittings; also for furnishing and applying about 15,000 gal. of oil on streets.

Ambridge, Pa.—Reported desired until Mar. 30 by Boro. Comm. (C. Earl Steel, clk.) for constructing improvements to waterworks, including tank of 100,000 gal. capacity, etc.

Erie, Pa.—Until April 6, by City Council, for constructing storm sewers and appurtenances; advertised in this issue.

Philadelphia, Pa.—Until April 10, by Dept. Pub. Wks. (Geo. E. Datesman, dir.) for constructing grit chamber in portions of Lycoming St., advertised in this issue.

Alliance, O.—Until April 27, by J. H. McConnell, dir. pub. serv., for furnishing c. i. water pipe and specials from April 1, 1917, to same date, 1918; pipes are to be bell and spigot of from 4 to 12 in.

Akron, O.—Until Apr. 18, by C. F. Beck, dir. pub. serv., for furnishing and erecting turbo-centrifugal pumps. G. G. Dixon, engr. Advertised in this issue.

Canton, O.—Reported desired until Mar. 28 by city for constructing Central Southwest storm sewer, including concrete outlet, brick concrete pipe, vitr. pipe, manholes, etc. W. E. Sarver, city engr.

Cincinnati, O.—Until March 30, by Chas. F. Hornberger, dir. pub. serv., for Cont. No. 2, Millcreek Interceptor, between Harrison and Marshall Aves., including 3,670 lin. ft. of from 90 to 93 in. concrete sewer; cost about \$166,615; also for Cont. No. 4, same Interceptor, between Mitchell and Spring Grove Aves., including 3,450 lin. ft. of 69-in. concrete sewer with 150 lin. ft. in tunnel; cost about \$179,770. Frank S. Krug, city engr.

Greenwich, O.—Until April 10, by F. H. Daniels, clk., bd. trustees of pub. affairs, for constructing waterworks improvements; advertised in this issue.

Cuyahoga Falls, O.—Until Mar. 28 (change of date) by Village Clk. for constructing sewers in portions of Water, Main, Front and many other streets. E. D. Barstow, village engr.

Wooster, O.—Until March 30, by Max Bloomberg, serv. dir., for constructing sanitary sewers in portions of Columbus Ave. and Emerick St.

Muskegon Heights, Mich.—Until April 2, by W. J. Barber, city recorder, for constructing about 22,852 ft. of from 8 to 24-in. sewer pipe and for sewage treatment plant. Hoad & Decker, engr., Ann Arbor.

Highland Park, Ill.—Until April 6, by Edward G. Huber, comr. pub. health and safety for constructing elevated steel water tank, capacity 200,000 gal.

Omaha, Neb.—Until April 10, by W. S. Jardine, supt. city imprvs., for constructing combined storm and sanitary sewers; cost about \$600,000. John A. Bruce, city engr.

Milan, Mo.—Until April 10, by City, for constructing sanitary sewers in Dists. 1, 2 and 3; work includes about 31,428 ft. trenching and backfilling, 31,668 ft. of from 8 to 10-in. sewer pipe laid, together with manholes, etc. E. T. Archer & Co., engr.

Fresno, Cal.—Until April 2, by W. H. Ryan, city clk., for constructing about 6 miles of brick, monolithic, cement and vitr. pipe storm sewer system; cost about \$175,000. Chas. E. Van Valkenberg, city engr.

San Diego, Cal.—Until April 2, by Bd. Superv. (John T. Butler, clk.) for constructing pumping plant, including pump, motor, discharge pipes and connections to wells, on Pueblo Lot. No. 1105.

San Francisco, Cal.—Until Apr. 7 by Const. Quartermaster, Ft. Mason, for improving water supply system at Presidio, here.

Murray City, Utah.—Reported desired until March 30, by W. Warenski, city recorder, for constructing sewer system, including septic tank. T. F. McDonald, city engr.

Simcoe, Ont.—Until March 31, by W. C. McCall, town clk., for constructing sewers and street connections and for supplying vitr. glazed sewer tile.

Winnipeg, Man.—Until April 16, by R. D. Waugh, chmn. comrs., for 13,300 ft. of from 48 to 60 in. c. i. water pipe; advertised in this issue.

PRICES AND LETTINGS

★Indicates award of contract.

Ft. Ann, N. Y.—Following bids opened March 15 by Bd. Village Trustees for waterworks construction: Louis J. Sieling, 171 Madison Ave., New York City, \$34,421; Suburban Eng. Co., 15 W. 38th St., New York City, \$38,532. All bids rejected, new bids will probably be advertised. Chas. E. Perry, engr., 82 State St., Albany.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MCGRAW-HILL PUBLISHING COMPANY, INC.

Volume 75

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Number 13

The Last Issue

WITH this number the Engineering Record, after an honorable career of 40 years, terminates its separate existence. We witness its going not without some regrets, though naturally we rejoice, when all is said, at the brighter future which is opening before it, due to its consolidation with *Engineering News*.

For 40 years it has been growing up with engineers and contractors, cherishing their aspirations, sympathizing with their difficulties, fighting their battles with them. Strong men, notably Major Henry C. Meyer, its founder; James H. McGraw, its present publisher, and John M. Goodell, editor during the period of its greatest development, have written their personalities into it. Major Meyer laid its foundations broadly—in truth, in courage, in high ideals. For 25 years he conducted it and won for it an enviable reputation for accuracy, sanity, breadth of view, and courage. Fortunate it was that when he wished to retire from active life there was available a publisher with the same high ideals, and with great ability, foresight and courage, to take up the work where he laid it down.

The present generation of readers knows what Mr. McGraw and Mr. Goodell did with the paper. Standing firm on the policies Major Meyer had established, they expanded it in size and scope in order that it might serve better the engineer and the contractor. That this service was appreciated is shown by the growth of the circulation in 15 years from 4000 to 20,000 copies.

Simultaneously with the consolidation of the Engineering Record with *Engineering News* the undersigned lays down his editorial pen. He may be permitted, therefore, to have a personal word with the readers in the issue which terminates both his régime and the separate existence of the paper. For four and a half years he has had the good fortune of occupying the editorial chair. Much honor has come with it and all too much credit for his humble part in the development of the paper in these later years.

Never has any journal been more truly the product of an organization than has been the Engineering Record. It shows clearly the impress of each and every man who is on the staff to-day. To Mr. Tomlin, as managing editor, especial credit is due. He has conducted the paper ably during the frequent absences of the editor. Moreover, his impress is shown in the human way of presenting articles, and in the use of graphic headlines and introductory paragraphs which

have helped to secure so wide a reading for the paper. Mr. Stark deserves all the credit for the excellence of the railroad material, and particularly for the sane and extremely vigorous attitude on valuation matters. Mr. Hammond has brought out the contractor's point of view, and through articles, editorials and the invaluable "Hints for the Contractor" has made the paper of exceptional value to those who execute the designs that the engineer prepares. Mr. Williams, during his brief two years on the staff, put a new spirit into the structural articles and enabled the paper to present probably a more noteworthy collection of articles on steel and concrete subjects than have hitherto been presented in the same length of time in any other paper. Mr. DeBerard and Mr. Bowers, as Western and Pacific Coast editors respectively, have cared with striking success for the engineering interests of the Middle West and the Coast.

But even this recital does not tell the story adequately. It does not tell the spirit with which each man worked. It was teamplay of the finest kind. Each man carried fully the responsibility of his own position, yet found time to boost the other fellow and to encourage him in his work, especially in the new ideas that each was constantly developing. It is that spirit which drove the paper ahead and that brought forth the frequent question a few years ago, "What has happened to the Engineering Record? It is developing by leaps and bounds."

And still the story is not completely told. What the editors did required money—much money—and that could not have been forthcoming were it not for the faith which Mr. McGraw and the business department of the paper reposed in the future of the field and in the plans that were being followed. Without their firm backing results would have been impossible. Then, too, no small credit is due those, particularly Mr. DeWolfe and Mr. Holland, whose typographical and artistic genius is responsible for the handsome covers and the pleasing and vigorous typographical appearance for which the paper has been distinguished.

One last factor—and a most important one—needs attention and then we shall close.

The editors can never adequately express their appreciation of the help and encouragement they have received from their friends outside the staff—engineers and contractors from Coast to Coast, from Canada to Mexico. They have given freely of material. They have com-

mended things well done. They have kindly criticised when they felt that our policies were wrong. Without their help and advice the progress would have been slower, the results less certain.

We trust that their good will and their disposition to help will be transferred undiminished to *Engineering News-Record*. We predict with confidence that the combined journal will do its utmost to deserve the continued and hearty support of engineers and contractors.

The writer's greatest regret in leaving editorial work is that he will lose the close contact with these friends of the *Engineering Record*—the engineers and contractors whom he can truly call his friends and who have been of such material help to him in the development of the paper. As an executive officer of the company which will own *Engineering News-Record* he expects to follow its development closely, to sit in at the editorial councils, and to have some influence in molding its editorial policy.

While his direct contact with the field, therefore, will be less than it has been in the past, he does not expect to be divorced from it entirely. Rather, his interest will be heightened, for he will have opportunity because of his semi-detachment and his supervision of papers in all of the five major engineering fields—civil, mechanical, electrical, mining and chemical engineering—to see the larger relationships of engineering and to aid *Engineering News-Record* in interpreting them to the field.

Au revoir, therefore, is the correct expression rather than farewell.



A Flareback

THIS journal has taken occasion in the past to criticise the cowardly attacks made, in unsigned circulars, on certain engineering materials, particularly for paving work. Possibly we should let the matter drop, for the average decent citizen has nothing but contempt for a sneak, and he is a sneak who sends out the literature to which we refer. Recently there was sent us by the city engineer of a Southern city a copy of an anonymous circular criticising a concrete street pavement. The engineer in his letter of transmittal said, "Concrete must be all right to bring this out and nobody willing to admit its authorship." In other words, just the opposite of the desired effect was produced. There was a flareback.

Undergraduate Preparedness

IN ORDER to be able to place before the students of Massachusetts Institute of Technology a clear view of the service they might render the nation in case of war, the Institute Committee, composed of one repre-

sentative of each of the student activities, has placed before the undergraduates a report admirable in scope, clarity and brevity. The committee conferred not only with members of the faculty, but with army officers and prominent business men. As a result it recommends that if hostilities come undergraduates withhold their service completely and await developments, in order that they may be placed where they can do the most good. The report points out that because of the limited experience and technical training of undergraduates, the services which they can perform are not apt at the start to carry heavy responsibilities, but that, nevertheless, their qualifications are such that positions may develop where they could be of much more value than if they enlisted before the whole situation could be properly studied. In addition to this sage counsel the report gives an analysis of the services which undergraduates might render in the army, in the navy and in the industries upon which the fighting arms depend. The step taken by the Institute Committee is an excellent one and deserves to be followed immediately by student or faculty bodies in all of our engineering colleges.

"Unless Your Justice Abound —"

THIS JOURNAL has repeatedly called attention to the need of a radical change in attitude on the part of employers if the relations with employees are to be put on a satisfactory basis. Gradually the doctrine of employing labor just as cheaply as one can get it, of making concessions in the way of working conditions only when they are wrung from those in authority, has given way to the standard of justice. We doubt, however, whether even this standard, if it is held coldly, will produce the desired results. Justice there must be, but justice tempered with a real interest in the welfare of the worker. "Unless your justice abound more than that of the Scribes and the Pharisees" expresses the idea, for we believe that the justice applied in industry, with few exceptions, has been the cold, grudging justice that the Master condemned. How that new justice—justice made truly even by interest in the worker—expresses itself in the conduct of some American organizations is probably better set forth in a book entitled "New Ideals in Business," by Ida M. Tarbell, than anywhere else in recent business literature. It tells how industries and workers have been benefited by the construction of new workshops, by the introduction of safety devices, by caring for the health of the working force, by better housing, by shorter hours, by incentives of various sorts—all leading to a stabilizing of industrial conditions. It is impossible here to go into details. The book can, however, be unhesitatingly recommended to those who are confronted with labor problems in any sort of organization. If they do not gather inspiration that will lead to improved relations with the workers, they are sadly lacking in that enthusiasm and vision which are prime essentials for leadership.

Culverts Free; Hauling Extra

IT IS IMPROBABLE that the duties of editing will ever pall on us as long as the present Board of County Commissioners of Laramie County, Wyoming, remains in office. There is a freshness in its method of attacking the question of highway specifications which makes the laborious documents ordinarily thought necessary seem strained and unnatural.

Surely the opening paragraph of the document before us is naive and comprehensive: "County to furnish grader and road finisher, which must be returned to Cheyenne at contractor's expense before payment will be made for work accepted." Then, relying upon the intelligence of the contractor, the second paragraph starts off: "They shall be 32 ft. wide, with gradual incline to the center of 18 in." Need anyone inquire as to what is to incline to the center of 18 in.? No! The chairman of the board is evidently dealing with men possessing remarkable intuition. But where detail is demanded, he becomes precise to a startling degree. For instance, "All rock must be thrown completely off the road." Then, to allow for a play of the individual ingenuity of the contractor, he continues: "All places where fills are especially required shall be made by teams either hired by the day, or the fill will be let by the yard."

The unusual economic conditions and the state of the labor market in Laramie County are illuminatingly presented in the following: "Culverts shall be put in by the contractor without extra charge except for hauling same to place where they are required." Nor would the chairman of the board in any way question the engineering skill and good common sense of the contractor by even insinuating that his interest in the common weal and understanding of road engineering is lacking. So, in mentioning the rather unimportant item of drainage, the specification is intelligently vague, reading as follows: "Ditches must be so made that they drain to the best advantage."

But do not think that the interests of the county are in any way neglected. This is provided for in a most complete manner, and with an economy of words which is as significant as it is startling. No long detailed description, no baffling "except that," no hurried reference to standards. No! The county simply built a specimen mile and the "specimen mile completed will be shown to bidders and all work must average up to, or be better than, specimen shown."

And to think that this gem of engineering description was born through a desire to save the county the per diem of the ordained county surveyor!

The Engineer as a Leader

THE POINT at issue is the present war and the undeniable supremacy of the engineer in the handling of its problems.

H. G. Wells, whose place as a thinker ranks only below his position as a novelist, has made this so clear in a recent book, "Italy, France and Britain at War," that to deny the conclusion would be futile. The professional soldier of the English army seems actually to be a hindrance, always blocking any advance in tactics or mechanical aids with his bland, "It isn't done, you know." Wells is particularly severe in the treatment of the officers of his own army, finding those of France and Italy far more eager to avail themselves of engineering stratagem. It is in fact to the technically trained mind that every new situation is put for solution, and each success of defense or offense is measured in terms, not of men and guns, but rather of transportation and construction. It is all too apparent, furthermore, that war has proved the military attitude toward troops, the harsh voice and senseless class distinction, must necessarily give way to an attitude of consideration which is strangely like that advanced by efficiency engineers as the highest form of discipline.

In its essence, modern war is simply an intensification of peace. Its problems are those of industry, more highly accented, condensed surely, but giving to the elements of time and space a consideration that makes much of the study of manufacturing problems seem childlike. Nor in the work of the engineer engaged in war is economy of material and accuracy of workmanship neglected; on the contrary, these last receive an attention which is remarkable in a process whose end is destruction rather than construction. The European conflict has shown that in all this detail, upon which successful warfare of to-day depends, the technical man, though trained in the art of peace, has not only proved his superiority in the handling of the secondary category of materials, but also has won universal acknowledgment on account of his understanding of purely human problems.

There is a point at which modesty ceases to be a virtue and becomes humbug. When a definitive crisis has arisen, and has been met not only adequately but with brilliance, not to acknowledge one's capability is an avoidance of responsibility amounting to laziness or even criminality. When peace finally comes, engineers, to quote from the presidential address of Henry C. Adams before the Society of Engineers, must show that they "are leaders and not merely workers—hewers of wood and drawers of water."

Notice to Subscribers

This is the last issue of the Engineering Record. Subscriptions for it will be continued automatically as subscriptions for Engineering News-Record. Those who have

subscribed for both Engineering News and Engineering Record will receive the combined paper for a time equal to the sum of the unexpired portions of both subscriptions.



Columbia River Jetty Rapidly Nearing Completion

North Enrockment Will Complete Control Work, Eliminating Huge Shifting Bar at a Total Cost of Over \$14,000,000

By W. P. HARDESTY
Portland, Oregon

THE COLUMBIA, the second largest river in the United States, is navigable for ocean craft for more than 100 miles, and provides access to Portland, Ore.; but entry to it is made difficult by an immense shifting bar. A jetty to the south of the mouth was started in 1885 and completed in 1913; but although supplemented by direct dredging, the channel across the bar has proved inadequate on account of the increasing draft of vessels. In 1905 Congress provided that if the south jetty did not establish an adequate channel with a depth of 40 ft. at low water, this jetty should be extended and a new one built on the north, or Washington side, of the river, to run directly seaward from Cape Disappointment, a projecting headland which fronts westward on the ocean and eastward on Baker's Bay.

Under this authorization, preliminary work on the north jetty began in May, 1912, and is now about 75 per cent completed. For nearly its entire length of 2½ miles the work runs about S. 50 deg. W., but turns nearly west when reaching a point just 2 miles from the south jetty, and then runs parallel to the latter, terminating just 2 miles north of the south jetty. The work should finally be brought to a finish some time during the present year at a cost of between \$4,500,000 and \$5,000,000, which, added to the cost of the south jetty, \$9,594,150, will make the total cost of the work about \$14,500,000.

Immediately to the north of the rocky promontory of Cape Disappointment is a saddle in the ridge not more than 20 or 25 ft. above low tide, separating Baker's Bay

from the ocean. Through this divide runs the tramway from the receiving docks in the bay to the jetty trestle in the open sea. Fort Canby, with rather ancient fortifications, has its landing on Baker's Bay, and to this point a plant used in the construction of the south jetty was transferred from Fort Stevens.

Receiving wharves, quarters, shops and a complete layout of railroad tracks were constructed at this new location, and since the bay was quite shallow at low tide a channel 11 ft. deep was dredged to accommodate the stone-carrying barges. This channel necessitated the removal of 2,100,000 cu. yd. of material.

NEW JETTY TRESTLE DIFFERS FROM OLD DESIGN

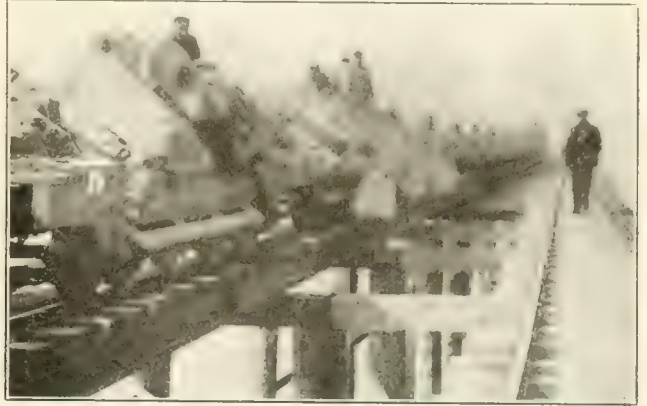
The experiment tried on the south jetty of using layers of burlap to protect piling against the teredo, having proved unsuccessful, was abandoned, and the principal reliance was placed on the use of green timber. No timber was cut dry, and any that might have dried for a few months after being cut was excluded from the work. It appears that the sap and pitch, being tenacious and sticky, does not form an attractive working medium for boring animals, experience indicating that green piles are usually exempt from an attack for about one year. After this period, the pitch has hardened and protection ceases. A further advantage in the use of green timber is that it is more elastic and better able for this reason to withstand the constant swaying caused by the heavy seas before the enrockment fully protects it from the waves.

Specifications called for a pile having a minimum top diameter of 13 in. and a maximum butt diameter of 26 in., some piles used running in length up to 120 ft. The trestle spans are 18 ft., each bent consisting of two pairs of piles, one for each track, which are framed together with eight 3x12-in. by 28-ft. pieces, two sets of two each being used on each side. This size of bracing was used in preference to 6x12 in. on account of the greater ease in handling. No longitudinal bracing was employed. The bracing was drift-bolted to the piles. The design is radically different from that used on the south jetty, extending about 20 ft. below the cap, while that on the south jetty reached only 7 or 8 ft., though the other details of the two trestle designs are similar. The tramway tracks are 3 ft. gage, spaced 13 ft. on centers.

ENROCKMENT KEPT CLOSE TO PILE DRIVING

The body proper of the jetty was formed by dumping rock from the trestles. This rock is of three sizes—Class A, from 6 to 15 tons; Class B, 1000 lb. to 6 tons; Class C, 20 lb. to 1000 lb. A certain amount of Class C rock was dumped as quickly as possible after the completion of the trestle work to riprap the bottom against scour. Experience on the south jetty made it apparent that it was a waste of time and money to build the trestle far in advance of enrockment, as the heavy storms repeatedly swept this trestle away. Due to this precaution, only six or seven bents were lost during the earlier work on the north jetty, and only one during 1915.

The teamwork of the men was so perfected that during one 8-hour shift 6 bents, or 108 ft., were built, including placing of caps, bracing, and placing of stringers. This is said to be double any other record made



VERY LITTLE ACTUAL HARM RESULTED FROM DUMPING ROCK

along the Pacific Coast for this class of work. Each pile was driven until the head was at the proper level, no cutoff being necessary.

TIDE SCAURED BOTTOM TO UNIFORM DEPTH

No estimate can be made from an advance profile of the bottom as to what the amount of stone on any part of the enrockment will be. Invariably as the trestle and enrockment were extended, the bottom just beyond the end scoured out rapidly, due to the sweep of the tide. Though the depth scoured depended somewhat on the length of time that the end of the trestle was left unprotected, a remarkable feature is that the amount of rock per linear foot differs only little throughout the work. For example, the enrockment at a location having a normal depth before scouring of 9 ft. was only about 15 per cent less than one with a 38-ft. depth.

Obviously, no uniform cross-section of enrockment under the conditions here existing is possible. The intention is to bring the top to about mid-tide after a full settlement and to widen the top to the full width of the trestles, or about 22 ft. Cross-sections of the completed enrockment show side slopes as steep as $\frac{1}{4}:1$, followed within 50 ft. by those of $1\frac{1}{2}:1$, averaging perhaps about $1\frac{1}{4}:1$. The $\frac{1}{4}:1$ slope is found far under the water.

125,000 TONS OF ROCK PER MONTH

The stone in broken bulk runs about 120 lb. per cubic foot, the weight, solid, being about 175 lb. per cubic foot, and is a sort of metamorphosed sandstone found only at a great depth in the quarries on the Columbia River. When the estimated amount of 3,000,000 tons has been placed, the rock will average about 250 tons per linear foot, or 4500 tons per bent. A record of the carloads dumped in each bent is kept, and by this means the total is known at least approximately. Considerable expertness has been obtained in dumping rock, and while cross-braces are often broken, no particular harm is done if the enrockment is well up.

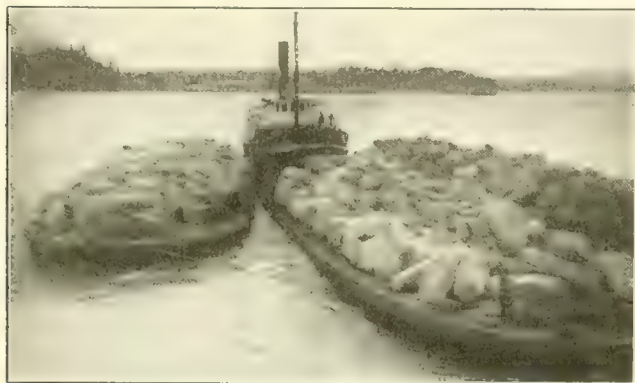
The stone is brought on fleets of three or four barges of about 900 to 1000 tons each to the special docks and tracks built at Fort Canby. Here the equipment consists of a dock with 10 tracks, 10 derricks, a steam plant for supplying the hoisting engines, twelve 17-ton locomotives and all necessary dump cars. In loading Classes B and C rock the car bodies are lifted from the trucks by derricks with a four-way chain attachment and are placed on the barges. Class A rock is handled



CLASS A ROCK IS SWUNG FROM BARGE TO CAR

directly from barge to mounted car body by derrick. Four barges can be unloaded at one time, two derricks being at work on each barge. All car handling is done by gravity, the locomotives picking up the completed trains and drawing them to the track scales, where the cars are weighted by twos. When working to full capacity, eight or nine train crews are employed, each with 10 cars, which handle about 90 train loads per day, totaling 125,000 tons of rock per month.

The enrockment begins 464 ft. out from high-tide shore line, or about one-half mile from the loading dock. The trestle is 12,303 ft. long and the enrockment

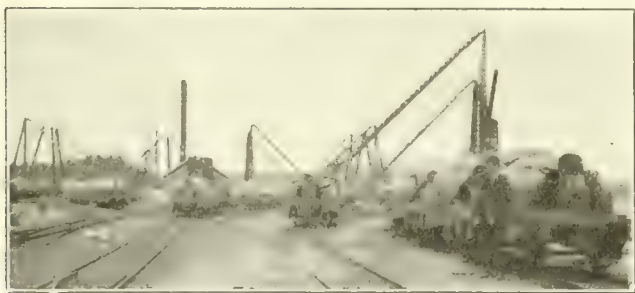


1000-TON BARGES TRANSPORT ROCK FROM QUARRIES ON THE COLUMBIA RIVER

11,839 ft. The three bends in the trestle are made with 6-deg. curves.

For safety in operation the main part of the trestle is divided into six blocks of about 1800 ft. each. During foggy weather an operator is stationed at each of the booths which separate the blocks and actuates semaphore boards about one train length away from the booth. Though there is telephone connection between booths, ordinarily the trains are so well spaced that no semaphore operation is necessary. However, as each train passes a booth the operator telephones ahead to the next booth, giving the number of the train, so that a complete tab is kept on the location of all trains.

Contract was entered into with the Columbia Con-



ALL ROCK TRAINS ARE MADE UP BY GRAVITY

tract Company of Portland to furnish and deliver stone for the enrockment at an average price of \$1.10 per ton of 2000 lb. Necessary supplies of lumber, fuel, etc., were purchased in the same manner.

Work began on the installation of the plant in May, 1912; on the trestle, during the fall of 1913; and the placing of rock began in February, 1914, though the plant was not fully completed until the summer of 1914. The total cost of placing 3,000,000 tons in en-

rockment, including the proper pro rata for all factors of expense, will probably be between \$1.50 and \$1.60 per ton. This depends somewhat on the appropriation available, as work done with a full force and without interruptions during the favorable season is much more economical.

All operations on jetty construction have been conducted by day labor under the direction of the Corps of Engineers, U. S. A. The jetties are included in the second Portland (Oregon) district. The district officers in charge of the north jetty, for the most part, have been Lieut.-Col. C. H. McKinstry and Major Henry C. Jewett. The U. S. assistant engineer in immediate charge of the work has been C. M. Cram, to whom the writer is indebted for data used in preparing this article.

Railway Engineers Compare Timber and Concrete Trestles

Committee Recommendations on This and Other Subjects Accepted at Eighteenth Annual A. R. E. A. Convention Summarized

THIRTEEN different committees of the American Railway Engineering Association were able last week to get recommendations adopted. These subjects, summarized below, will be printed in a supplement to the *Manual* until a new edition is authorized.

Roadway.—All the recommendations as printed in Bulletin 194 were adopted, including revisions of recommendations relating to steam-shovel work, blank forms, shrinkage or expansion of material in embankments, roadbed cross-sections, and conclusions as to grade separations.

Ballast.—It was concluded that the best quality of each of the various kinds of ballast should fall in about the following order of effectiveness: Stone, washed gravel, broken slag, pit-run gravel, chatts, burnt gumbo, or clay and cinders.

Definitions of the terms sub-ballast and top ballast were accepted, and also the conclusion that the depth of ballast under the tie, on roadbed material such as clay, loam, etc., subject to deformation by the application of live load, should be not less than the spacing, center to center, of ties. It was also concluded that a sub-ballast blanket of not less than 12 in. thick is effective in most cases in preventing mud working up into the top ballast.

Ties.—An additional specification for crossties was accepted to the effect that ties made from white oak, cypress and dense pine showing a greater amount of sapwood than is permissible for ties to be used untreated will be classed among ties to be treated; also one relating to the limitation of time after cutting and before delivery, the actual figure being left blank.

Track.—Specifications and designs for cut and screw spikes proposed were adopted, with a few minor changes, as were definitions of main line, branch line, spur and main track. A standard gage to test the screw spikes was adopted.

Buildings.—With minor changes, the convention accepted matter with reference to freight-house scales and ashpit designs proposed in Bulletin 194.

Wooden Bridges and Trestles.—Conclusions as to the

comparative merits of ballast deck and reinforced-concrete trestles were adopted as follows: Creosoted ballast-deck timber trestles present the greater fire hazard, are slightly less superior in their stability against the action of floods, give the same service, present no difference from appearance standpoint and are less in accord with the theory of conservation of natural resources.

The convention concluded as to the merits of galvanized-iron fastenings for timber trestles, as compared with plain iron and steel, especially in creosoted structures, that creosoted timber had a tendency to protect plain iron or steel when embedded; that the steel will last as long as the timber; that it is good practice to use steel drift bolts in straight creosote-treated timber; that galvanized fastenings exposed to brine drippings last longer, but that the information is not sufficient to state whether the added expense is justified, and that it is not necessary to use galvanized fastenings in creosoted structures over salt water.

The conclusion that creosoted timber trestles are more economical than concrete, except when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure, was not accepted.

Masonry.—Specifications for constructing concrete piles, for surface finishes of concrete, formulas on retaining walls and the standard specifications of the joint committee were adopted.

Signals and Interlocking.—Additional specifications and standards adopted by the Railway Signal Association were accepted for printing in the *Manual*.

Rules and Organization.—The clearance diagram adopted in parts last year, as redrawn, and reconciled with that of the committee on electricity, was adopted for new construction work.

Water Service.—A few minor changes, intended to render clearer the language in the *Manual* relative to softeners and to remove certain ambiguities, were adopted.

Yards and Terminals.—Three hump profiles proposed for cold, moderate and warm climates were adopted; also the conclusion that the maximum grade over track scales shall not exceed 1 per cent, and shall preferably be less than 0.6 per cent.

Iron and Steel Structures.—A new formula for impact, $I = 30,000 / (30,000 + L^2)$, where L is the total length of the span, was adopted to replace the present formula. It was concluded also that chilled cast-iron plates not less than 30 in. wide are the best form of protection to steelwork from locomotive blasts.

Wood Preservation.—Specifications for fractionation of creosote oil were adopted which conform to those of the American Wood Preservers' Association and those up for adoption in June by the American Society for Testing Materials. A standard apparatus for zone water sampling in creosote oil was accepted.

Wood Pipe Ages Less Than Iron or Steel

Based both on theoretical investigations and on field tests, the author of Bulletin 376 of the U. S. Department of Agriculture concludes that wood pipe will convey about 15 per cent more water than a ten-year-old cast-iron pipe or a new riveted pipe, and about 25 per cent more than a cast-iron pipe twenty years old or a riveted pipe ten years old.

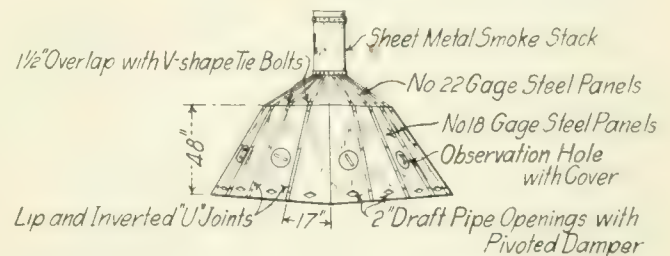
New Stump Burner for Logged-Off Lands Requires No Blower

Is Easily Handled, and with Minimum of Attention Will Dispose of a Large Stump in from 24 to 40 Hours

By LE ROY W. ALLISON
Newark, N. J.

AN INTERESTING and effective stump burner has recently been perfected to provide a thorough and practical means of reclaiming fertile lands covered with tree stumps, such as are found in great abundance in the western sections of the country. It is easily put together or moved, and requires little attention while in operation.

Various types of stump burners have been devised for clearing agricultural tracts encumbered with tree butts and underbrush, generally known as "logged-off" lands, as well as for other purposes for the direct utilization of the stumps. The Ross stump burner, described in the Engineering Record of July 25, 1914, page 95, manufactured at Portland, Ore., consists of a closed sheet-iron hood to be used in connection with a blower for



THIS STUMP BURNER IS EASILY PUT TOGETHER OR MOVED

draft creation within the hood for stump consumption. This burner has proved very efficient in service, particularly as regards rapidity of operation, stumps being consumed in from 2 to 4 hours, depending on the size and character. Another interesting use for stump-hood equipment has been found in the pine timber lands of Mississippi, where at Laurel such is employed to particular advantage in extracting heavy pine oils during the work of converting the stump into a fine grade of charcoal (see the Engineering Record of June 10, 1916, page 764.)

In contrast with the closed type of hood burner, this latest stump burner consists of a metal housing with various apertures for particular service, with smoke-pipe connection at the top. It is constructed in sections to provide for any class of service, covering both large and small stumps. By the use of movable draft pipes arranged around and near the base of the burner, it eliminates the necessity for any blower or other artificial draft device, the required draft being brought about by natural conditions and hood construction, and in a highly efficient manner for the service designed. While this burner operates more slowly through the use of natural draft, demanding greater periods of time for stump consumption, the operating cost is reduced to a minimum, the primary expense being that of labor and attendance, which is low when a number of burners are in operation on the same land at the same time.

This burner, known as the Hubbard stump burner and produced at Seattle, consists of an adjustable steel

hood of two principal sections to form a base and top, designed to be placed over the stump, or stumps, in operation. Each section is built up to any desired size by means of interchangeable panels, allowing the utmost facility in handling and erecting on the site. The lower section panels, when joined together, have a clear width of 17 in. at the base. Installed in position, using such number of panels as is required, they form a frustrum, with the upper edge to serve as the support for the top section. This top section also forms a flatter frustrum, terminating with an opening 12 in. or less in diameter, depending on the number of panels used, and is equipped with a smokestack, as shown. Each panel is arranged for connection to the adjoining panel in the field with stove bolts or strong cotter pins.

LOWER PANELS

The lower section panels are made from steel sheets of No. 18 gage. Each panel is of trapezoidal shape, 11 in. wide at the top, 19 in. at the base, and about 48 in. high. On one edge of each panel a $\frac{1}{2}$ -in. lip is bent at an angle slightly in excess of 90 deg., while the other edge is made in the form of an inverted U, $\frac{1}{4}$ in. wide and $\frac{1}{2}$ in. deep. Bolt holes are punched near the bottom and at the middle and top of each joint for the field connections. These field connections, as will be readily understood, are effected by inserting the lip into the U of the adjoining panel and bolting. The joints accordingly consist of three thicknesses of the sheet steel to a depth of $\frac{1}{2}$ in., acting as a stiffening brace or rib for each panel, and holding the entire hood base securely and accurately in place under all conditions of operation.

A 2-in. hole is provided in the center of each of the lower panels near the base for the insertion of draft tubes, consisting of $\frac{1}{2}$ -in. iron pipe; a damper is arranged to cover the hole when the draft pipe is not in service, being pivoted upon a single rivet. In addition to this draft aperture, every alternate panel is made up with an 8-in. hole for observation and utility purposes.

The upper section is composed of panels of sheet steel of No. 22 gage, similar in design and shape to the lower panels, with the same projecting lip and inverted U joint, and punched holes for bolting at the top and bottom of each joint. For connection with the corresponding lower section panels along the edge, on overlap of about $1\frac{1}{2}$ in. is provided, and fastened with tie bolts of V-shape design to effect a substantial bond between the two.

ADJUSTABLE SMOKESTACK

The smokestack, of sheet metal, is adjustable, and is supported by a metal band at the base and top of the cylinder. Lugs are riveted to the stack at the bottom for attachment to the upper section of the hood, four wires being passed through these lugs to form the connection. The exact circumference of this smokestack varies for the different number of panels used to make up the desired size burner. A 12-in. stack is employed with a sixteen-panel hood, a size of burner which has been found to be the most suitable and practical for ordinary service.

In erection, the lower panels are bolted together in groups of two, three or more to facilitate handling and moving. Following, the different groups are placed

around the stump area to be cleared and the remaining connections made with heavy cotter pins, thus permitting prompt dismantling and removal to other locations in the vicinity when desired. The roof sections are bolted together and the stack is attached before being placed upon and fastened to the base panels.

Prior to operation, the stump, or stumps, to be burned are cleared away sufficiently of dirt and debris at the roots to allow the kindling of a good fire. After the erection of the hood over the area, the fire is started by using the observation openings in the lower panels, while the draft pipes to be employed are inserted in position to render the best possible effect of the forced draft. The draft increases as the temperature rises under the hood, being augmented by feeding logs to the fire, as needed, after kindling.

The draft tubes are pushed in from time to time as the roots of the stump are consumed, while the number of tubes with which the hood is provided allows for a full play of the fire. The volume of hot air in the hood produces a constant and forced draft through each tube—a heat, however, which is not intense enough to affect the sheet steel hood, as the air supply is limited at the roots.

Recent tests on Washington timber lands show that this type of stump burner will consume stumps from 3 to 5 ft. in diameter, together with roots within the range of the burner, in a period of 24 hours, while larger stumps from 6 to 7 ft. are burned in 30 or 40 hours. In connection with a low first cost and operating expense, this stump burner offers particularly effective service in the field, both in installation and in removal to adjacent sites.

Reclaim Alkali Land by Simultaneous Flooding and Draining

Abandoned 150 Acre Tract in California Is Made to Produce Crops After Irrigating to Remove Alkali Salts

AN EXPERIMENT made to determine the effectiveness of flooding and draining alkali areas is the subject of a report recently issued by the Agricultural Experimental Station at Berkeley, Cal. Experiments were made on a 150-acre tract of land near Fresno, Cal., on which alkali was present to such an extent as to preclude its use for agricultural purposes. The results of the experiments are believed to have demonstrated the possibility of removing enough of the sodium salts to permit of the successful use of the land for agricultural purposes.

The land was first used about 1890, when a vineyard was set out upon it. A rising water table and the accompanying accumulation of alkali practically destroyed the vineyard. After this the land failed successively in producing alfalfa and grain. It was then abandoned and no crops were put in for several years previous to 1913.

Work on the drainage system commenced in 1913. The drains consisted of 6 to 12-in. tile, with a fall of 1 in 1000, placed at an average depth of about 7 ft. These drains discharged at the lowest point of the

tract into a sump, from which motor-driven centrifugal pumps removed the drainage water. After the drain tile was installed the canal system was put in shape and the irrigation checks were repaired at a total expense of \$66 per acre. The tract was then flooded intermittently to a depth of 6 to 12 in. After the flooding had been carried on during the spring season a crop of corn was raised which just about paid for the harvesting, indicating some progress in reducing alkali content.

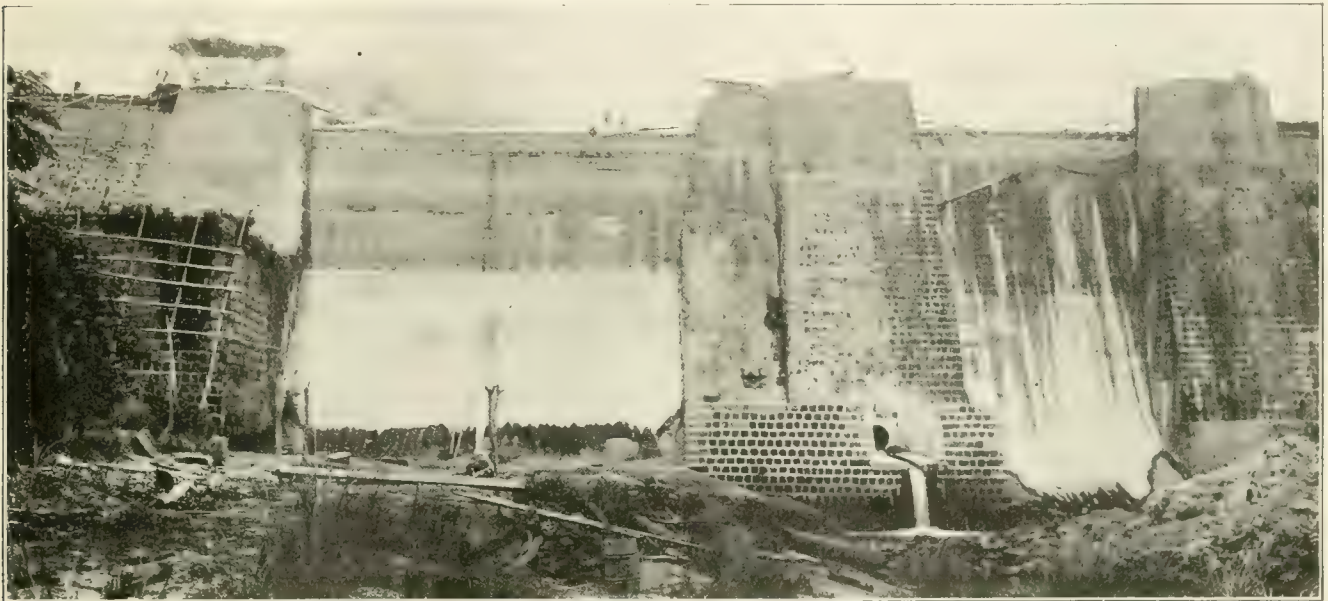
PUMPS OPERATED SIX MONTHS

In the following spring the tract was again flooded. The pumps were kept in operation continuously from March to September, and in this time handled 145,000,000 gal. in 1915 and 160,000,000 gal. in 1916. Water put on the tract was not measured. The tests of the soil made in successive seasons showed the following

Adobe Dam in Philippines Dewatered and Leaks Repaired

Irrigation System Threatened and Dam Rendered Unsafe—Work Carried Out by Bureau of Public Works

DEWATERING of an adobe dam in order to repair leaks in the upstream face was undertaken by the Bureau of Public Works, Philippine Islands, when leakage through and under the dam reached such a state as not only seriously to threaten the irrigation system, supplied by the impounded water, but also to put the dam in an unsafe condition. The repair work necessitated tunneling through the dam from the downstream face in order to dewater the reservoir, and consisted of building a wooden sluice gate, erecting a large buttress to strengthen the light gravity section of the dam, pro-



ADOBE BLOCKS SET IN LIME PLASTER PROVE HARD AND TOUGH IN TUNNEL EXCAVATION

average results, all of the soil samples having been taken from points within 1 ft. of the surface:

Year	No. of tests	SODIUM SALTS IN SURFACE FOOT		
		Per cent NaCl	Per cent Na ₂ CO ₃	Total
1913.....	122	0.0972	0.0401	0.1373
1914.....	119	0.0276	0.0406	0.0682
1915.....	138	0.0208	0.0338	0.0546

The total cost of this work in the successive years amounted to \$100 per acre, but this is about \$40 per acre more than would be normally required, the report points out, inasmuch as about \$20 per acre was required for the eradication of Bermuda grass and about \$20 per acre was involved in duplicate expenses for pumping and tile that would be unnecessary with the proper design and construction on another tract of similar character.

During 1916 the tract produced 180 tons of grain hay, and is believed to be in such condition that alfalfa can be successfully grown in 1917. Further cultivation and irrigation, it is pointed out, will cause the alkaline condition to change still further for the better

viding ample drains for seepage water, repointing seams and joints with cement-and-sand mortar, and building a curtain wall. The work was undertaken when the leakage amounted to 6 gal. per second, or 864,000 gal. per day. The work is described by C. R. Bennett, district engineer, in the quarterly bulletin of the Bureau of Public Works, Philippine Islands.

DAM BUILT WITH WEAK GRAVITY SECTION

The Tres Cruces Dam, as it is known, is located in the Cavité Province, about 4 miles up the Timalan River from Manila Bay. The present structure was completed in 1886, replacing another of the same type which was washed out in the seventies. It is, however, built with a gravity section so thin that buttresses on the downstream side and a clay bank on the upstream side had to be added later to make it more stable. One section 40 ft. long is 50 ft. high and only 20 ft. wide at the bottom. During the last few years the spillways have been badly damaged, one having been completely destroyed and the other about 40 per cent washed away. The structure was in such poor condition that the friar lands division of the Bureau of Lands appropriated \$15,000

for repairs, and requested the Bureau of Public Works to undertake the work. This was begun in December, 1915.

In order to stop the leaks in the face of the dam it was necessary to let the water out; and as no gate had been provided, a tunnel had to be excavated through the structure. This was located at the original stream-bed center, 46 ft. below the water line. The tunnel excavation was made 5 ft. in diameter and was lined with concrete to leave an opening 3 ft. in diameter. The adobe and lime mortar were so tough that never more than 3 lin. ft. was completed in 24 hours, although three eight-hour shifts, consisting of four men each, were employed. When the excavation reached the adobe on the upstream side the water was allowed to force its way through the clay bank and drain out. As this was going on, hundreds of natives gathered around with nets and buckets to catch the fish. It is estimated that at least 4000 lb. of fish and several hundred eels, some 6 ft. long, were caught.

SEAMS AND JOINTS CLEANED AND REPOINTED

After the dam was unwatered, every seam and joint on the upstream face was cleaned out and repointed with a 1:2 cement-and-sand mortar. A gate, made of 4-in. timbers, with a heavy, brass-bound frame, was built at the upper end of the tunnel. Two large buttresses were built, one between the spillways and one at the outer edge. The spillways were later surfaced with concrete. Ample provision was made to carry away seepage which might collect behind the concrete. In addition, a strong curtain wall was built across from the two buttresses at the outside edge of each spillway. All downstream joints in the masonry were then repointed. Finally an additional spillway was provided at one end of the dam.

Cost of Engineering an Extensive County Road System

On Work in Texas Totaling \$1,075,000 and Covering 178 Miles of Construction Engineering Cost Is 4.58 Per Cent.

By WILLIAM C. DAVIDSON

MCLENNAN COUNTY, TEXAS, has recently completed the construction of a road system consisting of 5 miles of concrete, 63 miles of waterbound macadam and 110 miles of gravel construction, entailing the building of 488 bridges and culverts. The total cost amounted to \$1,075,000, of which \$895,000 was expended on road construction, buying right-of-way, and defraying engineering expenses. Itemized cost records were kept throughout the work, and the following is a description of the items charged to engineering.

The center line of existing roads was followed as closely as practicable in running out preliminary transit lines, stakes being set at intervals of 500 ft. along one of the fence lines and hubs at all angle points. All data on right-of-way were recorded, including the distances from the center of the road to the fences on both sides, and stretches of road where no right-of-way existed were located. The size, kind and location of all bridges and culverts, character of the soil, the width and

depth of gravel on existing roads of this type, and the condition of the road with regard to drainage were noted. Wherever possible, the names of property owners were obtained and notes were made of the bearings and station numbers of side roads, fences and railroads. Data were secured from which the amount of clearing and grubbing might be estimated.

The level party followed the transit party, taking the profile of the center line of the road, the flow line of small streams and a ravine section of larger streams and creeks. Wherever it seemed necessary, the road was cross-sectioned and information was secured as to the extent of road subject to overflow during high water. For use in subsequent construction work, benchmarks were established at intervals of about one-half mile.

PRELIMINARY ESTIMATES MADE BY FIELD PARTY

As soon as the field data were obtained, the work of the entire organization was concentrated on the making of plans and estimates. This included a profile and alignment map of each road, a general map of the whole system, standard road sections and standard bridge and culvert plans. Tables were prepared showing the location and type of road to be built and the location, size and type of all bridges and culverts.

The organization as it existed during the field work of the preliminary surveys consisted of two field parties, each party having a level and transit organization. The transit party consisted of a transit man, two chainmen and a teamster who assisted in front and back flaggings. The level party was composed of a levelman and rodman, who, as in the case of the transit party, were provided with hacks and teams for conveyance over the roads. These outfits were owned by the county.

Work on the preliminary surveys, plans and estimates involved about two and one-half months, in which time 203 miles of preliminary line were run and plans and estimates made. The cost of this work amounted to \$3,014.30, or \$14.85 per mile. This is 0.28 per cent of the cost of the improvement, and included salaries, expense accounts of the men, cost of instruments, transportation, field books, tracing cloth and other material used in making up the preliminary estimates. The salary basis was as follows: Transitman, \$90 per month; levelman, \$75 per month; rodman, \$50 per month; chainman, \$45 per month, and teamster, \$50 per month.

CONSTRUCTION WORK DIVIDED BETWEEN TWO RESIDENCIES

The organization for handling the construction work consisted of a chief engineer, an assistant engineer for each of the two residencies, a general inspector for each of the five work divisions, two field parties, a bridge engineer, a chief clerk with one assistant, and a stenographer and material checkers, the latter varying in number in accordance with the demands of the work. Two divisions of the work were in one residency and three divisions in the other—the mileage of each residency being practically the same, and the cost of construction being about equally divided between them.

As the county furnished all the road gravel to the contractor, it devolved upon the engineering department to order this as the work progressed. Details of this work were carried out under the direction of the chief clerk, who was supplied with data as to the number of

cars needed each day by the assistant engineers or the inspectors. More than 300,000 tickets were issued for rock and road gravel, and since all such tickets were summarized in the office, it can be seen that this item alone involved no small amount of labor.

WORK OF BRIDGE ENGINEER

The bridge engineer was employed to design such bridges and culverts as could not be built in accordance with standard design. This work included principally the design of special overflow bridges and special I-beam bridges, occupying the designer's time for about three months.

Each assistant engineer as well as the county engineer was supplied with automobile transportation. Including the original investment for the cars, the cost of transportation amounted to \$4,164.53, or 0.39 per cent of the total expenditure. This figure seems comparatively high, but includes the cost of gasoline, oil, repairs and supplies, and part of it is traceable to the bad condition of the roads during the early part of the construction work. After much of the road had been completed the operating expense, except as to repairs, was materially reduced. The average drive per day per car was 50 miles. Each assistant engineer was required to cover practically 90 miles of construction work, some of which was situated more than 20 miles from the base. It would have been impossible to handle the field work without the use of an auto conveyance.

CHIEF CLERK IS CIVIL ENGINEER

The office organization consisted of a bridge designer at \$125 per month, a chief clerk at \$100 per month, an assistant clerk at \$75 per month and a stenographer at \$50 per month. The work of the chief clerk consisted in checking requisitions and accounts, ordering gravel to be shipped to the various spurs from day to day, compiling data for the monthly estimates and preparing drawings, maps and estimates incident to the construction work. Both the chief clerk and his assistant were graduate civil engineers, and hence could handle other than strictly clerical work. The total of strictly office expenses was \$6,520.18, or 0.61 per cent of the total expenditure, and included not only salaries, but drafting supplies, stationery, printing of all blanks used for reports and estimates, blueprinting and all other miscellaneous expenses.

With the aid of the data prepared by the office force the assistant engineers drew up the monthly estimates, and were responsible for them. These estimates were then passed to the county engineer for his approval. The assistant engineers had personal charge of all field work, and in general supervised the construction work under the advice of the county engineer, though the detail work was left largely to the inspectors who were required to make daily, weekly and monthly reports of the work under their charge. They had general charge of all the road and bridge work, except the running of lines, cross-sectioning for earth work, and the staking out of bridges and culverts.

All transportation for inspectors was furnished by the inspectors themselves. It was the further duty of the inspector to measure foundation excavation for bridge work and to classify it in accordance with the standard for this work. Furthermore, the inspectors assisted in

making out the monthly estimate, and computed all bridge and culvert work, though the earth work, clearing and grubbing was handled by the assistant engineer and his instrumentman, and the gravel and rock totals by the office force. Material checkers were employed under the direction of the inspectors to issue tickets for the rock and gravel delivered on the road and to see that a scheduled amount of each was placed at each station. The number of checkers depended on the extent of the outfits hauling material.

The total construction expense, including salaries of men and expense accounts, amounted to \$21,975.56, or 2.04 per cent of the total cost. A total of 508,000 tons of road gravel and stone was used in the construction of the system, and the cost of checking these materials amounted to \$9,171.07, or 1.8 cents per ton, which is 0.85 of 1 per cent of the total expenditure.

WHAT IS MEANT BY "ENGINEERING COST"?

The total field expense, including salaries of men and expense account, amounted to \$21,975.56, or 2.04 per cent of the total cost, while the total construction expense, including office, transportation and field, amounted to \$32,396.27, or a percentage of the whole of 3.01. This does not include material checkers, who should not be classed as engineers, but whose cost should perhaps be charged against material. The schedule of salaries going to make up this total, but not given before, is as follows: Assistant engineers, \$150 per month; inspectors, \$100 per month; material checkers at the rate of \$2 per day, or when employed on straight time \$45 per month.

The following is a summary of the engineering cost:

Items	Per cent of total cost
Preliminary surveys	0.28
Office expense	0.61
Transportation	0.39
Salaries and expenses	2.04
Total	3.32

If the county engineer's salary be figured for the length of time elapsing between the beginning of the preliminary surveys and the completion of the work, the cost will be increased by 0.41 per cent of the cost of the work. This added to 3.32 per cent gives a total of 3.73 per cent. If we should go a step farther and add to the foregoing percentage the percentage cost (0.85 of 1 per cent) for checking material, we should have a total cost of 4.58 per cent, which amounts to \$35,155.57, or an engineering cost per mile of \$197.50.

The chief engineer of the project was Rollen J. Windrow, of Waco, Tex., who is serving in the capacity of county engineer and road superintendent of McLennan County, Tex. Associated with Mr. Windrow as assistant engineers were J. M. Isbell and the writer, the former being in charge of Residency 2 and the latter in charge of Residency 1.

Claims 1,000,000 Hydroelectric Horsepower

Hydroelectric-power resources available for the city of Los Angeles total 1,000,000 hp., according to statistics recently published by the Bureau of Power and Light of the Los Angeles Public Service Department.

State Road Legislation Reviewed by American Highway Association

Complete Study of Subjects Which Should Be Considered in Laws Relating to State Highway Departments

ONE of the great social and economic problems facing the country is to increase the products of the country and to decrease their cost to the consumer. The two aims are not antagonistic. Better farming will produce better and larger crops with the same expenditure of money and labor, and better marketing facilities will reduce the cost of delivering farm products to the consumer. Better farming and better marketing depend on better roads. The average cost of hauling farm products over average country roads was found by a comprehensive investigation by the U. S. Department of Agriculture to be 23 cents per ton-mile, while the average cost of hauling over hard surface roads should not exceed 13 cents, and it is the townsman, not the farmer, who pays that 10 cents per ton-mile tax due to poor roads, according to R. Walton Moore, who was requested by the American Highway Association to make a study of the laws of the various states relating to highway departments, so that future legislation in the different states might be so drawn as to make possible the most easy method of constructing state roads. The following matter is extracted from his report.

POINTS TO REMEMBER IN ADJUSTING ROAD LAWS

For years to come a very large proportion of the roads in the country will remain under local control, and public interest requires that control to be of a high character. It will prove helpful in any adjustment of state road laws to determine broadly, first, what roads shall be put under the control of the state highway department; second, how these roads shall be selected; third, how the responsibility for the improvement and maintenance of these roads shall be divided between the state and its subdivisions; and, fourth, the organization and financing of the state highway department to discharge the duties assigned to it. When this is done, the laws relating to the remaining roads of the state should be reviewed to make sure that the new legislation does not unintentionally effect harmful changes.

While each state must decide for itself what duties shall be assigned to its highway department, and the detail with which the law shall prescribe the procedure to be followed by the department in the discharge of its duties, it is well to keep in mind that if such a department is to be held responsible for results it should not be hampered by restrictions upon the methods it may adopt to obtain such results.

CO-OPERATION WITH LOCAL BOARDS OF GREAT HELP

Although the highway department should be authorized to make all necessary surveys, the department should be authorized to call upon local boards for help in ascertaining the travel on roads. The Ohio law on this subject reads as follows: "The state highway commissioner or chief engineer may call upon the county highway superintendent to furnish maps of the county

showing distinctly the location of . . . public highways and deposits of road material, together with any other information that may be required by said commissioner or engineer. . . . The county highway superintendent shall have the right to call upon the township trustees or township highway superintendents to furnish any part of the information."

LEGISLATURES SHOULD NOT SELECT STATE ROADS

Opinions as to the necessity for simplicity of action vary considerably in different states. For instance, in Pennsylvania the main roads are designated by the legislature. As a result of this method there are 10,200 miles of Pennsylvania roads designated as state highway. The result is that during 1915 the department spent about \$4,500,000 in maintaining this mileage, and during 1916 it spent about \$3,000,000, with nothing of any great moment in the way of permanent improvements to show for it. Had this money been spent on a smaller mileage it would have furnished a satisfactory nucleus to the permanent highway system of the state.

On the other hand, in Illinois the highways receiving state aid are selected by the county officials, subject to revision by state highway commissions. This is somewhat better than the method adopted in Pennsylvania, but not so good as that in force in Massachusetts, where state highways are designated by the highway commission upon petition of local authorities.

No haphazard, disjointed method of improving main roads without a definite plan by which the work of to-day will eventually become a part of a complete system of highways will prove satisfactory. Secretary of Agriculture Houston placed stress on one important aspect of this in the following statement: "In accepting the terms of the Federal Aid Road Act, the state, as a matter of course, pledges its faith to the five-year program. This is important because it makes possible the arrangement of a comprehensive scheme of road-building." Where state funds are contributed to work done by local officials, the state department should be authorized to withhold state aid until the local authorities have provided satisfactory rights-of-way.

PROVISION FOR CAREFUL PLANNING SHOULD BE EMBODIED IN ALL LEGISLATION

The advantage of concentrating authority in a single commissioner is that a good administrator can accomplish more than a mediocre board, and it may be not so difficult to obtain a good administrator as it is to obtain a harmonious, energetic and capable board. On the other hand, a board composed in part of state officials and in part of civilians, including professors of engineering in state colleges, is perhaps more likely to be free from individual predilection, in closer touch with public opinion in different parts of the state, and apt to take a broader view of problems because relieved of direct responsibility for detail. However, excellent work is being done under both systems of administration.

In a number of states the highway commission consists of three or more state officials. In other states, the board consists of a few state officials acting with professors of engineering in state schools, and occasionally with two or three private citizens appointed

by the governor. In other states all the commissioners are private citizens. In many instances, the commissioners draw no pay but are allowed their actual expenses. Under any arrangement, however, the duties to be performed should be stated comprehensively and clearly in the law. The Ohio statute is a good example of this.

DUTIES OF STATE HIGHWAY DEPARTMENT OUTLINED

Among the most important duties of state highway departments as outlined by Mr. Moore are the maintaining of facilities for testing materials, collection of automobile fees and the issuance of regulations governing the use of vehicles on public roads, the investigation of the suitability of different types of road and bridge construction, the holding of public meetings to explain the desirability of road and bridge improvements, the preparation of standard plans and specifications for roads and bridges, the determination of the main roads of the state and the mapping of them, and the preparation of plans and specifications for roads and bridges built by the state and the supervision of their construction. In addition, the highway department should co-operate with local authorities in the following instances: Preparing or aiding in preparing plans for road and bridge improvements of a purely local nature; supervising and assisting in supervising construction and maintenance of roads under local officials; designating roads and bridge work on which state funds shall be spent; and the annual inspection of all bridges exceeding 30 ft. in length.

APPOINTEE POWER WHERE RESPONSIBILITY LIES

As a general rule, a department works best when it has authority to organize its own staff, but there should be no question about the importance attributed by the legislature to efficient engineering. The following clause, in substance, is desirable in the law governing any state highway department: "The state highway commission shall appoint a state highway engineer, who shall be a competent civil engineer, experienced in highway construction. It may appoint, subject to the approval of the commission, such technical assistants as may be necessary for the proper conduct of the engineering work of the commission."

In many states the actual purpose of the state highway department is essentially regulatory and advisory. It is intended by the legislature to be a preventive of inefficiency on the part of local highway authorities, and this purpose is accomplished by two general classes of statutory requirements, the first governing the class of men placed in charge of road work by local authorities and the second requiring the submission of plans by the local authority to the state department for approval before work can be undertaken. The Illinois plan is excellent in this respect, providing that all road construction not done under the immediate supervision of the state highway commission shall be performed under men whose fitness it has determined by competitive examination.

ENGINEERING CO-OPERATION WITH LOCAL OFFICIALS

There is very little uniformity in legislation governing the co-operation of state highway departments with local highway officials. This is undoubtedly due to the

tendency of lawmakers to add the highway department legislation to existing road statutes. Any legislative committee instructed to draft laws for the organization or reorganization of a state highway department should also be empowered to report on amendments to existing laws relating to local roads. As an instance of excellent legislation of this sort, each Iowa county is required to have a county engineer, who may be removed for incompetency by the state highway commission as well as by the county supervisors.

A weak feature of the road laws in many states is the indefinite manner in which responsibility for bridges and culverts is stated. A considerable proportion of the highway bridges of the country are unsafe. In some laws the departments are directed to hold annually a specified number of public meetings to explain road affairs to taxpayers and to issue bulletins on road subjects for general distribution. In West Virginia, for instance, the department gives annually a special course of instruction in highway engineering, and the law requires all county engineers to attend this course for at least ten days each year.

Experiment with Groins at Santa Monica Beach Successful

Wood and Concrete Structures Are Effectively Building Up Sand Deposits—Certain Precautions Must Be Observed

A BATHING BEACH on the ocean front at the north line of the city of Santa Monica, Cal., has suffered serious erosion and sand losses each year since 1913. On the advice of an engineer, owners of the bathing resort decided to experiment with groins. Preliminary studies of the beach developed that although the contour above mean tide was very steep, below that elevation the beach was flat, with occasional long depressions. The first depression was parallel to the tide line and about 70 ft. from it, while others with less defined limits were farther out. The prevailing current in all of these depressions was down the coast and carried considerable sand. The prevailing wind is almost due west, while the shore line lies along a line bearing about north 45 deg. west.

FIRST GROIN EXPERIMENTAL

The first groin to be constructed was made as an experiment while the owners were still skeptical about the actual benefit that could be expected to result. For its construction a small pile driver was rigged up on the rear end of a light spring wagon, using for a hammer a 100-lb. section of a eucalyptus log. Five men provided the motive power for raising the hammer and maneuvering the rig on the beach. The driving was assisted by a jet of water from the city supply mains under a pressure of about 80 lb. delivered through a 3/4-in. nozzle on a 2-in. pipe. Where boulders were encountered, 4-in. pipe was used as posts, or 3/8 x 3-in. iron bars were driven to which the bottom board was bolted, and this in turn was bolted to the post which supported boards above. The joints between planks were covered with 1 x 4-in. battens.

Having been constructed in this comparatively haphazard manner, with a maximum penetration for the

posts of probably less than 6 ft., the structure could not withstand the stress to which it would be exposed on an unprotected shore line. Most of it was destroyed by rough weather about three weeks after its completion. However, in these three weeks the sand deposits had accumulated to a depth of 3 ft. on the windward side, and the success of the scheme had been proved.

CONSTRUCTING THE GROINS

With this encouragement, a gasoline-engine-driven pile driver with a 700-lb. hammer was put into service, working from a temporary trestle, and the three other groins shown in the accompanying photograph were built. The construction consisted of two 4 x 4-in. posts, 6 ft. apart, to which 4 x 12-in. planking was bolted. The timber was Oregon pine, and was promptly attacked by marine borers, so that its life will probably be very short.

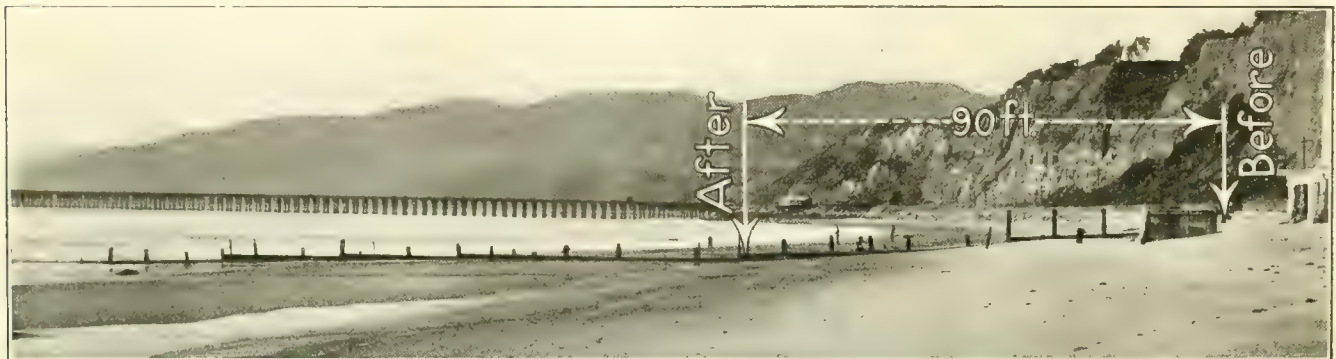
One of the chief construction difficulties was getting the bottom plank to the necessary depth. On account

but the high groins caused a deposition of sand only on the up-current side. As each wave sweeps along the beach and over the groins, the height of the drop gives the water a force sufficient to sweep away the sand which would otherwise deposit on the down-current side. In addition to the irregularity of the beach, the exposed high groins are unsightly. Both these disadvantages could have been avoided by building up the groins gradually, board at a time, as the sand accumulated on both sides.

CONCRETE PLACED BETWEEN POSTS

It was found almost impossible to keep the seaward end of the groins tight, so concrete was placed between the posts for a height of 1 to 2 ft. above sand level. This has served the double purpose of anchoring the posts and keeping the joints tight.

Since the new groins have been put in several severe storms have occurred, but the only damage caused resulted from piles which have broken away from the



ARROWS SHOW BEACH LINE BEFORE AND AFTER USE OF LOW GROIN

of the short time during which work could be carried on at low tide, and the number of boulders encountered at this level, great care was required to prevent leaving a small space under the board. At least one plank had to be below sand level, it was found, for if there was any chance for the current to cut underneath this would be enlarged until the entire seaward end of the groin would be above sand level and of no service until another plank could be placed below the one previously put in.

NECESSARY PRECAUTIONS

Another point which required careful attention was the placing of battens, for even a small crack between the planks was fatal to the success of the scheme. Even the hole left by withdrawing a misplaced $\frac{3}{8}$ -in. bolt would cause extensive damage. The water would spurt through this hole and would dig out a crater 8 or 10 ft. in diameter on the up-current side of the groin, and this would destroy the action of the groin to seaward. Once the groin was tight, however, the action was rapid and new plank could be placed almost overnight.

As reconstructed, the experimental groin was built eight planks high at the shore end, adding the planks as the beach built up. The other groins, however, on account of the impatience of the owners, were built high as soon as the first two boards had been covered, the desire being to build up the beach along shore with the greatest possible rapidity. The desideratum, which was a flat playground for bathers, was accomplished,

long wharf and floated against the groins. They battered away about 20 ft. from the end of groin No. 2 and about 20 ft. from its central portion. The gap was replaced by a concrete wall.

These storms came from the south and seemed to cause a reversal of the littoral drift which took away the sand deposit for about 20 ft. at the outer ends of the groins. This checked up previous observations, which indicated that south and sometimes southwest winds set up a "scouring tide" as a result of which the outer 20 ft. of the sand deposits are not considered permanent accretions.

Summing up the result of experiment and observation thus far on this work, it may be said that the groins must begin above highest water line; the bottom must be at least 6 in. below sand level and the entire groin absolutely watertight; that it does not pay to use perishable construction materials; that the impatience of owners must be restrained, keeping the groins low and building them up as the beach develops; and that the first groin to be constructed should be on the down-current end of the beach.

The foregoing notes and observations have been supplied by Wilkie Woodard, civil and landscape engineer, of Los Angeles, who induced the owners to experiment with groins. Mr. Woodard's recommendations for permanent groin construction have not been carried out, but the experimental work and the temporary construction have afforded encouragement for more stable structures which will probably be built.

Save Shop Costs and Insure Economy by Proper Design Details

Complete and Comprehensive Design Drawings Advocated—Advantages in Uniformity of Sections and Duplication

THAT design drawings should be complete and comprehensive in order to save time and misdirected effort in the drafting room and allow early ordering of material; that economy results from simple designs with uniformity in the structural units and details; that as few sections as possible varying by relatively large thicknesses should be adopted throughout a given design, and that simple splices should be used are the principal points made in a discussion of "Factors Affecting Costs of Structural Steel Shop Work," by E. W. Pittman, manager, McClintic-Marshall Company, Pittsburgh, and G. H. Danforth, structural engineer, Jones & Laughlin Steel Company, Pittsburgh, before the Engineers' Society of Western Pennsylvania. From the December *Proceedings*, where these two papers and the opinions of several members are given in full, the following abstracts have been taken.

GENERAL DESIGN DRAWINGS SHOULD BE COMPLETE

When the design drawings, said Mr. Pittman, are complete and comprehensive, much time and misdirected effort are saved in the drawing room. If time permits, it is customary to make the shop drawings and check them before compiling a list of the steel required. Generally, however, it is necessary to order the steel from the rolling mills promptly, using a few preliminary sketches and layouts. If the mill order involves a great variety of shapes, a considerable period sometimes elapses between the beginning and the completion of deliveries from the mill. This, of course, enhances the difficulty of storing the steel and having it accessible for use in the shop at the time when final delivery is accomplished. It is not economical, as a rule, to start the fabrication of a structure until all the steel is delivered.

The largest single factor, according to Mr. Pittman, in determining the cost per pound of steel in a structure is the design rather than any special or unusual requirements as to workmanship. If utility and economy are the governing considerations, the design should be as simple as possible. The number of members and the number of pieces in each member should be reduced to a minimum. Complicated connections and splices and bent work should be avoided as far as practicable. The use of a great variety of sections and of sections not often rolled should also be avoided.

USE STANDARD SECTIONS

This is especially important, he said; if quick delivery is a consideration, as it is easier to procure mill rollings of a few standard sections than of a great many, including some unusual ones, such as T-beams, Z-bars and deck beams. It is always well to go over a design after it is finished and make a list of the different kinds of sections shown. Generally it will be found possible greatly to reduce the number without materially increasing the weight.

In ordinary structures, such as small bridges, viaducts

and buildings, Mr. Pittman thinks it best to make liberal use of beams, channels and H-columns in place of short lattice struts and trusses and built-up columns. Designs made up of fretwork of such lattice members and plate-girder crane runways may be redesigned in the interest of economy with H-columns in place of built-up columns, beams in place of roof trusses and lattice struts, and girder beams in place of plate-girders. The cost per ton to the purchaser for the manufacture of the original design, exclusive of the cost of steel, might be about \$15 to \$18, while the cost for the revised design should be about half this amount. Of course, the substitution of rolled sections for built-up sections sometimes increases the weight slightly. Using these figures as a basis of calculation, however, and knowing the base price of steel at any time, it is an easy matter to determine just what increase in weight would be compensated by the decrease in cost of fabrication.

In the design of shallow plate girders, according to Mr. Pittman, it is sometimes economical to increase the thickness of the web plate $1/16$ in. beyond the thickness required to resist the shearing stress when such increase renders it possible to dispense with stiffener angles and fillers that would otherwise be necessary. Likewise, it is often economical to distribute column loads over a masonry footing by means of a thick slab rather than by means of a number of stiffener angles, wing plates and diaphragms at the base of the column. Stiffeners at the bottom of a column require careful planing and fitting to be effective, and frequently involve many hand rivets.

REAMING OF IMPORTANT FIELD CONNECTIONS

In bridge work it has become common of recent years, said Mr. Pittman, to require the assembling and reaming at the shop of important field connections, or else the reaming of such connections through a steel template. This adds considerably to the cost of fabrication, but it generally saves more in the field than it costs in the shop. This requirement should not be made, however, without a careful study to determine its economy. Sometimes a connection may be reamed cheaper in the field if it is easily accessible without scaffolding.

One of the important points brought out by Mr. Danforth is that it seems impossible for some people to make details without getting rivets into pockets, where they are very difficult, if not impossible, to drive; or without building up a section which has to be partly assembled and partly riveted before the remainder of the sections can be put together and the piece finished. There is also a tendency to use an excessive number of rivets. A few excess shop rivets are not serious and do not appreciably increase costs unless the excess is great. The contrary, however, is true in regard to field rivets. Frequently field rivets are put in with a free hand, utterly regardless of what it will cost the erector to drive them.

GOVERNING PRINCIPLES

In the discussion, Samuel E. Duff, consulting engineer, of Pittsburgh, listed the governing principles as follows: Uniformity of design; use of easily obtained and competitive material; standardization of details; selective control of shop operations, and technical administration of erection work.

For several years the system of selective control, or

standardization of operations, he continued, has been highly developed in many industries where enormous numbers of exactly similar things are produced, such as the automobile, the electrical apparatus and the agricultural implement industries. Practically to apply these principles to a business like the fabrication of structural steel, it is only a matter of adopting the proper yardstick by which the standardization is to be applied. Some excellent results have lately been obtained in this way and a great advance will be made along this line in the next few years. The tendency now is strongly toward the placing of this matter in the hands of engineers, and all engineers employed by fabricating companies should make it their business to study the principles of selective control and standardization of operations.

The application of the fifth principle, technical administration of erection work, said Mr. Duff, has been a slow but steady growth. It has come about largely through the fabricating and erecting contractors, who are now often called upon to handle enormous weights, and to put together large structures within close limits of measurement and within the shortest possible time. Efficient machinery and technical methods are being frequently employed on small jobs, and engineers have a wide opportunity to reduce the cost of erection by these means.

Mr. Danforth does not favor the making of elaborate drawings by the owner's engineer. He believes that while some clients imagine that because an engineer makes elaborate drawings he should be paid a higher fee, the investors are now beginning to learn that the man who gets results is the man who should be paid, regardless of how much time or drawing paper he uses.

Calls Hydrogen in Oxyacetylene Tanks Dangerous

After Investigating Causes of Explosions California Commission Limits Hydrogen Content to 2 Per Cent

DURING July of last year there occurred in California, within three days of one another, three explosions of tanks used in oxyacetylene welding work. The accidents caused the deaths of seven men and seriously injured five others. An investigation was immediately undertaken, as a result of which it was urgently recommended that no oxygen containers be used in which there was present more than 2 per cent of hydrogen. The entire story of the investigation, which was conducted under the direction of John R. Brownell, superintendent of the department of safety, Industrial Accident Commission, has just appeared in the first issue of *California Safety News*, from which the following has been taken.

All three explosions occurred in tanks of oxygen supplied by the same manufacturer, who had used what is known as the "electrolytic" method in obtaining oxygen. Each explosion occurred immediately after a new tank of oxygen had been put in use, and all were found to be due to the presence of an explosive mixture of gases in the oxygen tanks. The pressure in the three tanks varied from 350 to 2200 lb. per square inch. Five other tanks were recalled from customers to whom they had been shipped by the same manufacturer. The con-

tents of these tanks were carefully analyzed, with the following results:

Tank Number	Per cent O ₂	Per cent H ₂	Per cent CH ₄	Per cent N ₂
N10959	99.5	0.6	0.1	0.4
N11063	54.25	42.5	0.53	3.18
N13003	28.3	69.0	0.30	2.43
N 9233	42.3	52.55	0.6	4.6
N10789	41.05	55.0	0.48	2.98

The investigation developed the fact that while these tanks were being filled it was necessary to make repairs to one of the electrolytic cells at the company's plant, and one of the repairmen accidentally interchanged the feed-line connections of a set of twenty cells, causing the poles to be reversed, and resulting in the mixture of hydrogen with the oxygen which went to the container from which the tanks that later exploded were filled.

COMMISSION'S RECOMMENDATIONS

The commission pointed out that oxygen manufactured by the liquid-air process does not contain hydrogen. If oxygen manufactured by other processes is used it should be ascertained that the hydrogen content be less than 2 per cent. The user of oxygen made by the electrolytic process, the commission recommends, should satisfy himself that the following precautions are taken by the manufacturer:

1. Every electrolytic oxygen plant should be equipped with a system of purifiers, the purpose being to eliminate, as far as practicable, the presence of hydrogen in oxygen.
2. All electrical connections should be so constructed that they will be non-interchangeable.
3. A device should be installed for the purpose of preventing reversal of current between the generator and the cell connections.
4. High-pressure gages should have safety relief features.
5. Tests of both hydrogen and oxygen should be made every two hours where the capacity of the system exceeds 100 cu. ft. per hour. This test should be run alternately with gas obtained from the gas holder and from the line between the cells and the gas holder. (The purpose of the test is to check up the gas being shipped out and also the gas which is going into the gas holder.)
6. Each plant should have gas holders of sufficient size to take the capacity of the plant for at least two hours.
7. All hydrogen tanks should be provided with fittings which are non-interchangeable with those of the oxygen tanks. It is recommended that the former be left-hand fittings and the latter right-hand fittings.
8. Each cell should be equipped with a "relief" feature, the purpose being to safeguard against back pressure.
9. A complete record of each test, as well as any important features connected with the process, should be kept and turned over to the management or authorities competent to examine it.

10. A competent operator should have supervision of the plant. He should be thoroughly familiar with the making of tests and the reconstruction of cells, and should be sufficiently acquainted with electricity and its application to electrolytic oxygen manufacturing competently to take care of any disturbances.

Twin 100,000-Gallon Tanks Designed with Spherical Bottoms

Atlanta Warehouse Company Tanks Under 37-Foot Head Are 158 Feet High—Punched Steel Plates Used at Construction Joints

SUPERIMPOSED twin reinforced-concrete tanks for the Atlanta Warehouse Company, each of 100,000-gal. capacity, supported by a four-story tower, making the total height above the foundations nearly 160 ft., form one of the most unusual structures of this type in the country. Two coats of water-gas tar applied in connection with a dense gravel concrete mixed in the proportions 1:1½:3 were found to produce watertight tanks. Cantilever balconies at two levels are provided, and access to the top of the tanks is attained by an outside spiral stairway of reinforced concrete cast independently of the tanks and supported by cantilever brackets at intervals of about 15 ft. horizontally. Construction joints are made tight by 18 x ¼-in. steel plates punched along the outer edges to give good bond with the concrete.

These tanks are used to supply the sprinkler system for the reinforced-concrete cotton warehouses covering an area of 40 acres.

GENERAL DESIGN DATA

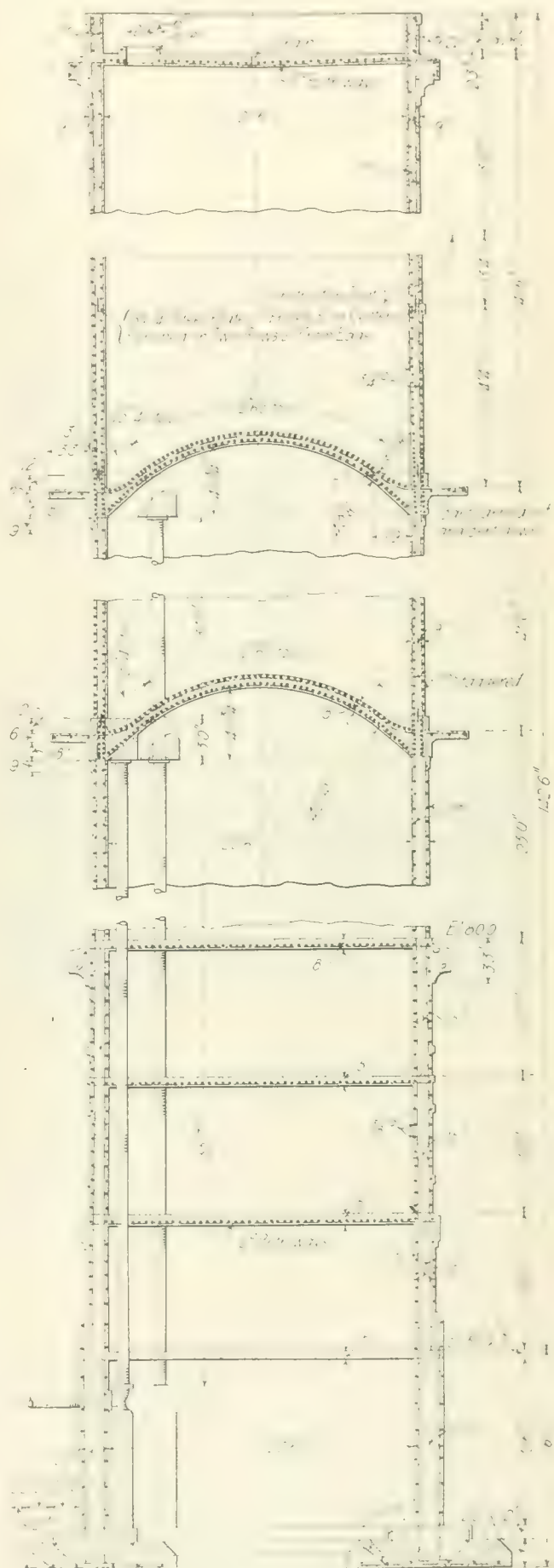
The allowable working stresses in steel and concrete were specified at 16,000 and 400 lb. per square inch respectively. The foundation soil, a stiff clay, was considered capable of supporting 2½ tons per square foot, after being leveled up with grout before the reinforced-concrete spread footing was poured. Wind pressure was considered at 30 lb. per square foot of the diametrical area for the cylindrical surface.

Usual design formulas for cylindrical containers were applied in the design of the 9-in. concrete walls of the tanks, assuming the steel to carry all the tension and varying the spacing of the staggered 1-in. circumferential rods from 3¼ in. at the bottom to 12 in. at the top of the tanks, which are 37 ft. deep. Vertical ¾-in. rods inside and outside are clamped at joints by two 1-in. cable clamps. A parapet and a cornice are furnished at the roof, as indicated on the drawing.

The design of the spherical tank bottoms was based on the theoretical analysis of Rankine's hydrostatic arch applied to dome theory. The reinforcing steel is circular and radial, the radial steel varying in length and stopping at four different distances from the center. These radial rods are ½ in. round, spaced 6 in. apart at the circumference (22 ft. 6 in. diameter). The circular ½-in. rods are continuous, wound in the form of a spiral, and clamped with ½-in. cable clamps, two to each lap.

CONCRETE PLATFORM AROUND TANKS

As seen on the drawing, the upper radial rods extend outward 3½ ft. and bend down 4 in. into a concrete platform carried around the bottom of each tank. The weight of tanks and water is carried by the walls of the tower, varying from 12 in. at the top to 24 in. in thickness at the foundation. Doors and windows are provided in this four-story part of the structure for the offices. The walls are reinforced vertically by 1-in. rods between windows, forming in effect eight columns below

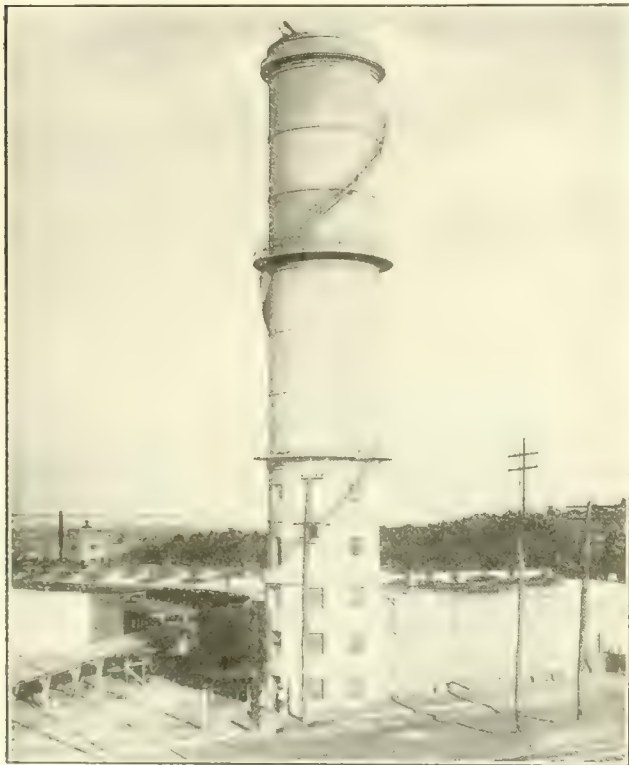


CROSS-SECTION OF TANKS AND TOWER, SHOWING REINFORCEMENT AND SPHERICAL BOTTOMS

El. 80 down to the ground floor at El. 50. The story heights are 10 ft., except the top floor, which is of 25 ft., the latter used for the purpose of storing the records of the warehouse company.

SPIRAL STAIRS—CONSTRUCTION JOINTS

Winding around the outside of the tower above El. 80 is a spiral stairway of reinforced concrete 1 ft. 7 in. wide, with $7\frac{1}{4}$ -in. treads and 8-in. risers, reinforced by $\frac{3}{4}$ -in. rods. This stairway is supported at the cantilever balconies and at intermediate points by brackets 15 in. wide and 12 in. deep connected to the walls of the tanks by four bent $\frac{3}{4}$ -in. rods. These brackets are



SUPERIMPOSED TWIN TANKS AND TOWER 158 FEET HIGH

spaced about 15 ft. apart horizontally and 13 ft. vertically, corresponding with the construction joints.

Construction joints occur at about 13-ft. intervals in the tanks, and in order to insure watertight conditions an 18 x $\frac{1}{4}$ -in. steel plate was punched with 1-in. holes 2 in. from each edge and embedded half in the concrete below and half in the concrete above. The holes increase the bond between concrete and steel, and the joints have shown no evidence of leaks.

WATERPROOFING USED

The concrete is a 1:1 $\frac{1}{2}$:3 mix, with gravel not exceeding $\frac{3}{4}$ in. in size for the large aggregate. The tanks were painted on the inside by two coats of water-gas tar—the first coat a thin grade and the second coat a heavy grade. The first coat was used as a primer and to prepare the surface for the second coat. The concrete has shown no evidence of leaking under full head of water in the tanks.

The design was made by E. A. Stuhrman, designing engineer for Arthur Tufts, contracting engineer of Atlanta, Ga. The contract was let on a percentage basis. The tower was completed last year.

Engineers Finding New Field of Activity

Abstract of Prize Paper on "Engineering and Civic Progress" Points to Increased Appreciation of Engineers' Worth

NEW FIELDS for engineers and their special fitness for them were discussed in a prize paper on "Engineering and Civic Progress" by Harvey T. Hill of Chicago. The prize, \$50, was offered by Subdivision 63, Engineers, Chicago Association of Commerce, in the hope of developing the relationship of the engineer and of engineering to the business and professional world and of determining how best to realize the conceived ideal of engineering. The judges were Prof. F. H. Newell, Dean John F. Hayford and John W. Alvord. Mr. Hill's paper opens with the query, "What is an engineer?" He answers it with the classified qualities with which Prof. C. R. Mann of the Carnegie Foundation stirred the profession to action. An abstract of the paper follows:

A WRONG IMPRESSION

Too often, says Mr. Hill, men are of the opinion that the duty of the engineer is to be a student and master of things, and that he does not need to possess a forceful personality combined with executive ability. How such a false cloak as this could have been enveloped about our engineers is a puzzle.

A feeling is becoming prevalent that the same plan of careful forethought which has solved problems of engineering should be applied to a wider field. The old idea was that the place for the engineer in the solution of civic problems was that of an adviser. He was considered a good man to consult once in a while, but should not be given power to execute his expert knowledge. Quite often those who went to him for advice were not competent to appreciate the valuable information he could give. This attitude is changing, until to-day we find the engineer being placed in positions of responsibility where he executes as well as plans for civic improvement.

FILL POSITIONS WITH EXPERTS ONLY

Horace J. Bridges said in a recent talk before the ways and means committee of the Chicago Association of Commerce on the subject "Can Efficiency Be Combined with Democracy?" that there should be laws passed in the United States analogous to those passed in Germany, allowing only those men to be candidates for office who have special expert training fitting them for that office. He also said: "Expert equipment for the particular job to be undertaken is what makes a real democracy. Who would think of the head of a health department being other than a doctor? Who would think of a state's attorney being other than a lawyer?" It is a pleasure to say that these positions are generally logically filled as far as the profession of the one chosen is concerned.

What about the commissioner of public works? Who ever heard of such a commissioner in Chicago being an engineer? What about Chicago's Board of Local Improvements? Who ever heard of an engineer being on that board? Yet its work is of an engineering type and demands the service of an experienced engineer rather

than simply an expert politician. Still another class of misfits are our county commissioners, who have charge of awarding thousands and sometimes millions of dollars' worth of construction, highways, bridges, etc. Here again the chair of the frank, honest, uncompromising engineer is filled by the clever politician. The recent appointments by the State of Illinois to the new public utility commission illustrate this point perfectly. Had it not been for the persistent efforts of the Western Society of Engineers there would not have been placed a single engineer on the commission. As it was, one engineer was appointed.

Those few fields that have been mentioned typify well how our present form of politics in many cases retards the efficiency of our government. As one passes over these facts he is led to ask whether the ever-increasing cry for efficiency will not soon bring about a decided change that will put the right man in the right place.

When our attention is diverted to the newer developments of civic life it is found that better conditions exist and that the engineer is receiving more nearly his just dues.

CIVIL SERVICE ELIMINATES THE UNWORTHY

Civil-service examinations tend to accomplish, in the departments in which they are held, the end which Mr. Bridges pleads for in all civic positions—which is to fill every position with an expert. The scope of civil service, as it is related to engineering, is broadening each year.

Large and small corporations demand special fitness in behalf of their employees. If such is the ideal of business, it should, and will, eventually become the ideal of political and civic life.

The city-planning systems which have recently been developed and are being developed impress upon us the dependence of civic progress upon the engineer. It requires an engineer's mind to plan new transportation systems, new street systems, new parks and other places of recreation. Without a plan it is impossible for you to execute.

The incorporation of the city manager into the list of city officials has opened a new field of public usefulness to the engineer. In the search to find the most capable men to fill these important positions the engineering field has been the hunting ground. In the majority of cases it has been the men of engineering training and experience who have qualified to carry on the work. Dr. Frank Crane emphasized this thought in a recent article on "The Engineer" when he stated: "We need the engineer to manage a city as economically and smoothly as if it were a manufacturing plant."

THE ENGINEER IN CHAMBER OF COMMERCE WORK

At the present time civic improvement is one of the outstanding activities of the chambers of commerce of the American cities. Many of the comforts of life we enjoy exist as a result of the never-tiring labor of some of the most prominent business men through the medium of chambers of commerce. The civic use, yes the civic necessity, of the chambers of commerce insures the prominent position these bodies are to hold in the future. Their organizations are of recent development and are free from traditions and customs of a time

that is out of date, such as often hamper civic and political organizations.

Many of the accomplishments of the chambers of commerce have been credited to the efficient work of the engineering members or to the engineers in the employment of the chambers. Of the latter class the New Orleans Association of Commerce and the Chicago Association of Commerce stand out as the leading examples.

The promoters of the association at New Orleans recognized in the engineer more than a builder of bridges, dams or machines. They saw in him a community builder. As the engineer expresses it: "Those with problems to solve have come to the appreciation of the concomitant imagination, ingenuity and good judgment of the man of well-rounded engineering education and experience with the ability to visualize the abstract and plan and execute it into the concrete."

HANDLING ENGINEERING COMPLAINTS

Although the industrial engineer can serve the cause of civic progress in an indirect way by helping to adjust the industrial misfits of his city, other classes of engineers often aid in a less roundabout way. The Chicago Association of Commerce has an engineering staff that has been working along direct lines upon special civic questions. In 1911 this association first employed an engineer, Louis A. Dumond, who at present handles all engineering complaints and inquiries or work of an engineering nature. Five short years ago the engineering staff of the Chicago Association of Commerce consisted of a temporary appointee to aid a specific committee, while to-day two civil engineers scarcely find time to complete the work they are called upon to perform.

One of the early undertakings of the committee on downtown streets was to study the various methods of locating and maintaining public utilities. The large number of holes, especially in the downtown section of the city pavements, influenced the committee to make a thorough investigation of what other parts of the world were doing to reduce to a minimum the number and the frequency of these disagreeable openings.

The lack of proper lighting in the business sections of Chicago was realized by the Association of Commerce. As a result it became instrumental in greatly increasing the light on Dearborn Street from Lake Street to the Dearborn Street station.

INSPECTION OF NEW PAVING

The Chicago Association of Commerce is the only association of its kind that takes an active interest in the inspection of the new paving in the city it represents. A small portion of its citizens realize the service that is rendered them by the engineers of the association. A member of the engineering staff inspects the material on each new section of street paving, as well as the workmanship of each job. This is done with a double view in mind—first, to see that all work is done according to the specifications, so that no one is slighted or favored; second, to study the construction and life of different types of streets, thus making the association useful as an adviser to the city regarding any changes to be made in the present specifications.

The engineers representing the Association of Com-

merce have no legal authority to go on the street construction jobs and tell the contractor to make such changes as may be necessary in producing the best street under the given specifications. Nevertheless, they have become recognized in Chicago's street construction as influential factors. Everyone, from the Board of Local Improvements to the contractors, appreciates the fair, constructive and perfectly neutral attitude of the Association of Commerce in this activity. This phase of the association's work has gained such a prestige that it is able to save the public thousands of dollars each year, as well as being influential in helping to raise the quality of Chicago's street construction.

Face of Concrete Dam Imitates Stratified Sandstone

Strips of Muslin Laid Along Face of Work and Backed by Loose Sand or Clay Give Concrete the Special Finish Desired

THE NEW concrete arch bridge and dam completed at Deer Park, Ill., in the upper part of Deer Park Cañon near golf grounds, contains a special concrete finish for the face of the abutments and the lower side of the arched dam. A dam 30 ft. high was built at this site in 1901, and last summer it was decided to raise this 18 ft. higher by an arch about 8 ft. thick at the base and 2 ft. 6 in. thick at the top. In order to harmonize with the stratified sandstone rock which forms the walls of the cañon it was decided to form the face of the concrete into horizontal layers or ribs. This was accomplished by using muslin strips backed by loose sand and clay.

As a highway bridge was desired near the site of the dam, it was decided to combine the abutments for an

the water is forced out by gravity and sprays over quite a distance along the ledge.

HOW IMITATION ROCK WAS OBTAINED

The stratified appearance of the concrete surface was obtained by constructing the usual timber forms, allowing about 1 ft. extra width for the facing, and then using strips of muslin along the front face of the work



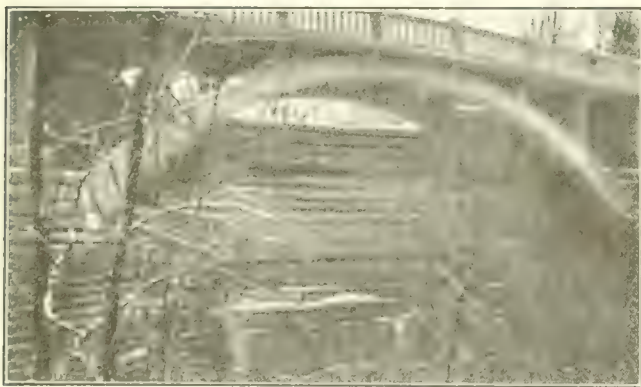
HIGHWAY ARCH APPEARS TO SPRING FROM STRATIFIED ROCK

with loose sand or clay placed between muslin and form and about 1 ft. high. The muslin was then drawn tight with its backing pushed into the desired form, and the concrete placed behind it, utilizing a relatively dry mixture and stiff mortar faces. By varying the thickness of the layers, a very fair imitation of stratified sandstone was obtained, the cloth giving the surface of the concrete the desired sandy appearance.

The plans for the bridge and dam were prepared by O. C. Simonds & Company, landscape gardeners, and the work was carried out under their supervision. The foregoing information was furnished by F. M. Button, a member of the firm.

Advocates Concrete Pile Bents for Economical Highway Bridges

After briefly reviewing the history of highway-bridge development, C. E. Nagel, deputy state engineer of the State Highway Commission of Minnesota, in the paper presented before the Northwestern Road Congress at Chicago, advocated the use of concrete pile bents combined with an economical type of reinforced-concrete superstructure. A concrete cap cast around the ends of the piles acts as a support for the spans, the economical length of which is about 20 ft. between bents of three piles each driven to a bearing of 20 tons. No abutments need be used, as the bridge should be made long enough to provide sufficient waterway after allowing for the 1:1 slope of a fill at each end protected by riprap. The Minnesota commission has designed a cellular slab bridge using curved corrugated-iron forms, which results in a saving of one-third in the volume of concrete. Trestle bridges can be built in multiples of standard span lengths, and metal forms and steel falsework would then be economical. In conclusion he says: "We believe that these bridges can be built with a saving of from 25 to 40 per cent under the cost of the present types and that they will prove far more satisfactory in the long run, and so are preparing plans for bridges of this type for next year's construction."



FACE OF ARCH DAM GIVEN SPECIAL FINISH TO IMITATE ROCK

arch bridge with those for the dam. The bridge, of 16-ft. roadway, is built on two arch ribs 24 in. square at the crown and 2 x 4 ft. in section at the abutments. These ribs have a radius of 40 ft., the span being 70 ft. for the downstream rib and 50 ft. for the upstream rib. The abutments are combined with those for the new arched dam, and are finished on the faces, as indicated by the photographs.

As the new part of the dam is to be used for reservoir purposes, bent pipe with valves are placed at about 5-ft. intervals so that water may be drawn off as high up the face of the dam as possible. These pipes connect with a molded ledge extending along the face of the dam

Effects of Exposure on Tar Products Reported by Federal Chemists

Usually Accepted Laboratory Tests Shown to Be Faulty as an Index of Permanence of Materials for Pavements

THAT changes occur in bituminous substances on exposure to the action of air and sun has been known for some time. These are not due merely to the volatilization of lighter oils, but molecular rearrangements, inter-reactions and oxidation play their parts. The work of extending this knowledge to the field of coal tars was undertaken by Charles S. Reeve, chemist, and Benjamin A. Anderton, assistant chemist, of the U. S. Office of Public Roads, who described their researches before the Franklin Institute in a paper, from which the following matter has been extracted.

Two refined coal tars, one refined water-gas tar, one refined mixed tar, two tar-asphalt mixtures, and one crude coke-oven tar were chosen and subjected not only to the usual laboratory tests but to exposure in a box designed to allow a dust-free circulation of air as well as the action of the sun's rays. The exposed samples were in quadruplicate, permitting a periodic examination of the tars during the three months' duration of the test. Besides the usual Engler distillation, the specific gravity, viscosity, bitumen soluble in carbon disulphide, free carbon, and the float-test time were determined, and the dimethyl-sulphate test run on the two tar-asphalt preparations.

Care was taken to insure a symmetrical disposition of the 28 samples with respect to the artificial-air circulation and access to the sun's rays. On the afternoon of April 21 the containing box was set on a shelf outside a window having an open southern exposure. As early as the following morning white flaky crystals of naphthaline had formed on the under side of the covering glass, the sublimation being greatest over the specimen of crude coke-oven tar. This disappeared as the temperature rose, but was succeeded later by an irregular deposit of a red, gum-like substance partly soluble in ethyl alcohol, but almost insoluble in carbon disulphide or benzol.

The average loss on a set of samples tested at the end of each month of exposure checks reasonably with the losses on the individual samples for the same period, indicating that the values obtained in testing the residues thus obtained are fairly comparable from month to month. All samples began to lose weight immediately on exposure, and these losses were progressive except in the case of the heavy refined coal tar, where the residue, after the second month, showed practically no change.

It is evident that the organic matter insoluble in carbon disulphide increased gradually. This may be seen from Table 1, in which this organic matter is referred to as "free carbon," although it may be partly composed of alteration products of tar distillates similar to the gum-like substance previously referred to.

It seems probable that there was an error in the determinations of free carbon at the end of the first month, but unfortunately sufficient material was not available for a check test.

From a calculation of the free carbon based on the loss of volatile matter, and a comparison of this with the figure representing the actual percentage, it is evident that the increase of free carbon is not due to volatilization alone. In every case the calculated percentage is shown to be less than the actual percentage and the greatest difference occurred in samples wholly or partly of water-gas tar.

To secure comparable data between the distillation

TABLE 1—TESTS ON SAMPLES SUBJECTED TO EXPOSURE

Time of exposure in months	Refined coal tar 32° C	Refined mixed tar 50° C	Crude coke-oven tar Fluid	Refined coal tar 50° C	Tar-asphalt mixture 32° C	Water-gas tar preparation Fluid	Refined water-gas tar 50° C
	15"	4'29"		2'16"	1'30"		2'21"
					50° C 42"		
	Float test.....						
	Free carbon	19.36	17.13	8.77	29.65	14.57	2.47
							0.72
	Per cent loss, average of 4 specimens	10.17	2.27	17.68	7.26	10.76	19.32
	Per cent loss, specimen tested	10.32	2.39	17.92	7.34	10.76	19.71
1	Float test at 100° C.....	24"	41.6"	30.3"	60"	34.1"	33.5"
	Penetration, 25° C.....	190	47	82	16	116	111
	Free carbon	25.21	22.46	14.94	33.18	19.46	8.31
							3.06
	Per cent loss, average of 3 specimens	12.08	3.23	19.81	7.87	12.11	22.37
	Per cent loss, specimen tested	12.12	3.23	19.85	8.09	12.07	22.15
2	Float test at 100° C.....	33"	44.8"	37.5"	78.5"	34"	38"
	Penetration, 25° C.....	79	31	48	8	51	41
	Free carbon	23.56	20.06	15.15	32.51	18.73	9.27
							4.69
	Per cent loss, average of 2 specimens	13.47	3.87	21.32	8.08	13.01	24.24
	Per cent loss, specimen tested	13.39	3.77	21.21	7.85	12.84	24.18
3	Float test at 100° C.....	41"	55"	47"	78"	48"	59"
	Penetration, 25° C.....	50	28	18	11	47	19
	Free carbon	23.64	21.40	15.90	33.60	20.68	10.02
							6.97
							6.67
							49"
							20
							6.9

test and the results of exposure, samples of the original material were fractionated in accord with the methods in use in the U. S. Office of Public Roads. Besides the

TABLE 2 TESTS ON RESIDUES FROM EXPOSURE AND DISTILLATION

Material	Residue	Per cent residue	Float test, 100° C.	Penetration, 25° C.	Per cent free carbon
Refined coal tar	Distillation to 315° C.	80.11	45"	32	25.21
	Distillation to 264.4° C.	85.80	34"	158	23.75
	Exposure 3 months...	86.61	41"	50	23.64
Refined mixed tar	Distillation to 315° C.	95.30	53"	24	19.69
	Distillation to 312.1° C.	95.18	49"	37	20.15
	Exposure 3 months...	96.23	55"	28	21.40
Crude coke-oven tar...	Distillation to 315° C.	80.96	27"	142	12.94
	Distillation to 343.6° C.	77.55	38.5"	41	12.93
	Exposure 3 months...	78.79	47"	18	15.90
Refined coal tar	Distillation to 315° C.	85.76	84"	5	35.50
	Distillation to 269.0° C.	91.18	68.5"	17	33.35
	Exposure 3 months...	92.15	78"	11	33.60
Tar - asphalt mixture	Distillation to 315° C.	77.93	114"	2	21.11
	Distillation to 259.7° C.	85.53	37.5"	55	19.30
	Exposure 3 months...	87.16	48"	47	20.68
Water-gas tar preparation..	Distillation to 315° C.	76.66	26"	167	3.86
	Distillation to 327.2° C.	74.34	43"	68	3.30
	Exposure 3 months...	75.82	59"	19	10.02
Refined water-gas tar....	Distillation to 315° C.	95.95	29"	138	1.29
	Distillation to 329.6° C.	92.16	42"	66	2.36
	Exposure 3 months...	93.33	49"	20	6.09

end temperature of 315 deg. C., a separate distillation was terminated at the point which would leave a residue corresponding in amount to that resulting from exposure for three months.

It may be seen from Table 2 that, while distillation and exposure conditions were maintained as nearly uniform as was possible, there is a difference of 84 deg. C. between the maximum and minimum temperatures to which the tars were distilled in order to attain the same amount of residue as that left on exposure. With the exception of the coke-oven tar, those samples consisting in all or part of water-gas tar had to be distilled to relatively higher temperatures.

CONCLUSIONS

It is realized that the action of air and sun upon bituminous materials in their pure state, as carried on in this work, is probably very different from what it is when the material is in actual service, but the work as pursued would seem to point to the following conclusions:

1. Upon exposure to service conditions tar products materially harden to a much greater extent than can be attributed to loss of distillate alone.
2. The changes which take place, other than loss of distillate, are accompanied by formation of organic matter insoluble in carbon disulphide.
3. Tar products containing water-gas tar appear to change to a greater extent than coal tars, as indicated by the greater formation of organic matter insoluble in carbon disulphide.
4. The comparative consistency of pitches obtained from distillations of tars to a single arbitrary temperature does not represent the relative behavior of the tars in service.

Los Angeles Seeks Additional Water Rights for Aqueduct

The state water commission of California has received applications from the city of Los Angeles for right to appropriate 500 sec.-ft. of water from the Owens River system and 250 sec.-ft. from the south fork of Kern River to be used in supplying the city with light and power. Several hydroelectric plans are involved, according to the announcement of the commission. Of three plants to derive power from Owens River, one calls for a hydraulic fill dam 150 ft. high and 520 ft. long with a concrete core wall. This plant would take water principally from the Long Valley reservoir site. Low concrete dams are to be used for the other two Owens River plants. The heads on these three plants would be 1100 ft., 829 ft. and 384 ft. respectively, and the theoretical power involved would be 41,000, 34,000 and 15,000 hp. respectively. The fourth development, to be known as Kern River No. 2 power project, calls for a small diversion dam from which 13½ miles of conduit would convey the water in such way as to utilize a total fall of 2540 ft. and develop thereby a total of 45,000 theoretical horsepower. The Owens River filings are in accordance with plans already outlined, but the Kern River project is understood to be a new and separate proposition. Its waters are not tributary to the aqueduct.

Drive Small Cofferdams 40 Feet Deep in Six Hours Each

Piles Set Around Mast Carrying Hammer—Jets Excavate Foundation Wells for Buffalo Electric Plant in Two Hours

A LARGE number of small circular concrete and steel-sheet-pile piers were constructed through 40 ft. of mud and quicksand for the new power house of the Buffalo General Electric Company without ever pumping out the wells. The steel-sheet piling for wells in successive lines across the site was rapidly assembled, by two traveling cableways, around masts, each set on a pile in the center of each well, each mast carrying an upper template and also supporting the steam hammer for driving. Only six hours were required to drive the steel for each well and 2 hours on an average to excavate each with a jet pump. The concrete was placed under water with a tremie.

LARGE COLUMN LOADS CARRIED TO ROCK

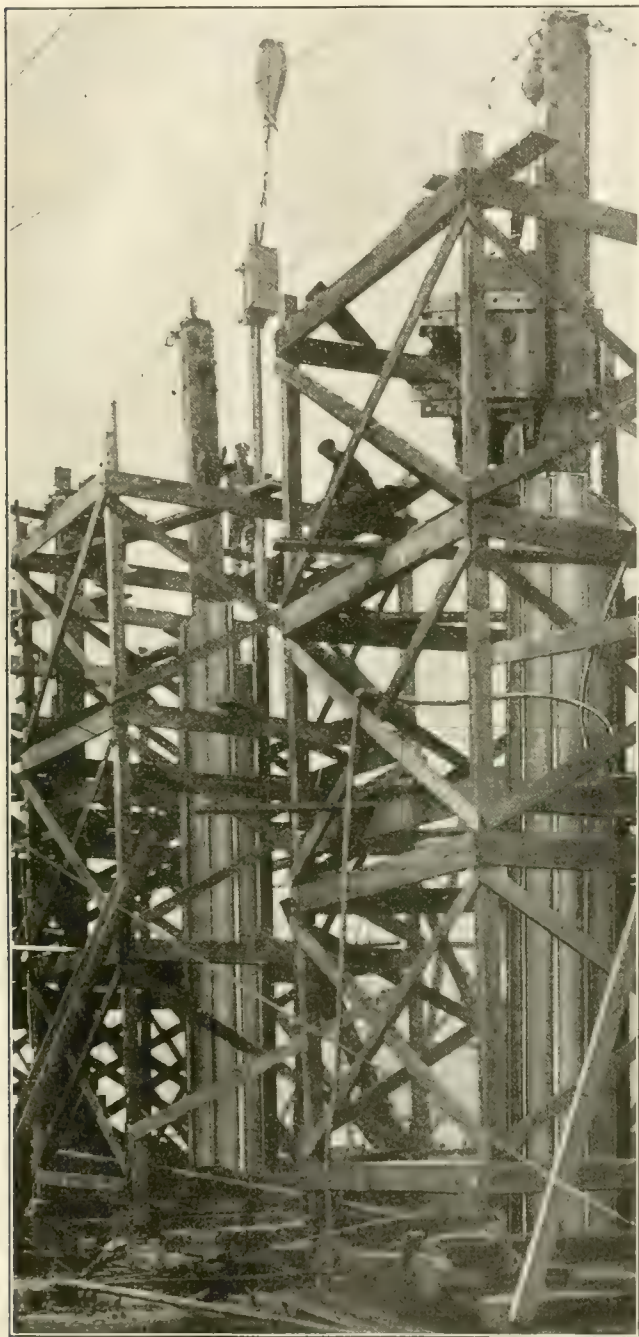
The power plant, which will have a capacity of 100,000 kw.—one of the largest steam plants in existence—is located near Buffalo and close to the Niagara River, in order to secure the large quantity of condensing water required. At the site selected on the river, however, the rock was 40 ft. below ground level and overlaid successively by 3 ft. of clay and boulders, 28 ft. of quicksand and 9 ft. of soft mud. The steam-generating plant to be supported on 157 footings represents a load exceeding 50,000 tons, and many individual columns must carry more than 850 tons apiece. The piers constructed to carry the building consist of reinforced-concrete shafts placed inside circular wells of 12-in. Lackawanna steel-sheet piling driven to rock. These piers vary from 40 to 81 in. in diameter. For the smaller wells, the web of each piece of sheeting was curved at the mill, but for the larger ones this was unnecessary.

CENTER PILE DRIVEN TO CARRY TEMPLATE

The piling was handled and assembled by two traveling cableways, each clearing the ground by 70 ft. This made it possible to thread the piles, which were 33 ft. in length, before any driving was started. To make these wells vertical and of full section all the way to rock, a large timber pile was driven at the center of each, to which a template of exact size was rigidly secured at ground level. In addition, the top of the pile was bored at the exact center of the well for a 3-in. pin on which a mast could be mounted to support an upper template. An 8-in. diameter iron band was placed around the head of each pile to prevent splitting. The masts, twelve of which were used to allow the sheeting to be assembled fast enough to keep five hammers busy driving, were of 14 x 14-in. timber, 42 ft. long. They were free to revolve about the 3-in. pin in the bottom and were secured by four guys each at the top. The upper template was fastened to each about 17 ft. above the lower one.

The hammers were handled from well to well by the cableways, but were supported in driving by steel cages fitting around the masts, the whole arrangement being raised and lowered by a set of falls to the top of the

mast, the lead line of which ran to a hoist on the ground. As the mast was free to revolve, the hammer could be carried around the entire circle, driving two piles together a few feet at a time until rock was reached. As the piling was to remain permanently in place, it was driven hard against the rock to prevent material coming in from the outside and interfering with the work of cleaning the bottoms. The steel-sheet



SEPARATE EQUIPMENT FOR SETTING AND DRIVING INCREASES SPEED OF CONSTRUCTION

piling for the 157 wells, amounting in all to 1300 tons, was entirely set and driven between Jan. 15, 1916, and April 6 following, only 70 working days being required in spite of an extremely severe winter.

The jet pumps used each consisted of 6-in. pipe about 40 ft. in length, inside which two 1 $\frac{1}{4}$ -in. water jets were installed. There was a valve at the top of the large pipe which was shut before the pump was set in

a well and kept closed until the small jets had carried the pump practically down to the clay. The large valve would then be opened and the pump allowed to run for about two hours, when all soft material would generally be removed from the well. These jets were supplied through an 8-in. main and 6-in. distributing pipes with water at 125 lb. pressure. The pumping plant consisted of a 1500-gal. multi-stage centrifugal pump. An extra jet was used to wash down material sticking to the sheet piling inside the wells.

The hard clay and boulders overlying the rock were broken up by raising and dropping a 35-ft. 13-in. sheet pile, after which this material could be removed with a small orangepeel bucket. The sand pump would then be replaced to clean up the bottom. In this work, two independent jets were used, one with a vertical and the other with a horizontal nozzle. The bottom of each well was carefully sounded all over with a long pipe rod to make sure that all clay had been scoured off. The method is stated to have been very successful in cleaning out all pockets and corners between the sheeting and the rock.

CONCRETE MIXER MOUNTED ON CAR

Railroad tracks were laid through a number of the lanes between lines of casings, so that the concrete could be placed upon a mixing plant located on a flat car. This was supplied with material by a locomotive crane. The reinforcing for each pier was made up in a unit and lowered into place before concreting was begun. The concrete was spouted from the mixer to the funnel of an ordinary tremie, which was raised and shortened by removing sections as the concrete came up. The bottom of the tremie was kept about 2 ft. below the top of the concrete and the pipe was kept full at all times. Concrete was carried to an elevation about 2 ft. below the top of the steel sheeting and allowed to set for two or three days, after which the water was pumped off and a concrete cap placed to carry the column footing.

The work is being carried on for the Buffalo General Electric Company by the Stone & Webster Engineering Corporation, for which S. L. Shuffleton is in charge as superintendent.

Give Costs of Blasting Drainage Ditches

Costs of blasting drainage ditches on the Montana Agricultural College Experiment Station farm are less than that of hand-dug ditches. Circular 55 of the station states that the ditching was done in soil very gravelly and full of large stones, making digging difficult and expensive. Two sticks of 60-per cent Hercules dynamite were placed in holes 22 in. apart, this distance being determined by experiments to be the most desirable for the soil conditions. About twenty-five holes were usually fired at one shot, the middle hole being used for the primer. A length of 647 ft. was blasted at a cost for labor of \$1.31 per rod. The expense of cleaning the ditch after blasting was 27 cents per rod, which is included in the foregoing cost. Dynamite, caps and fuse for the job cost \$1.05 per rod (dynamite at 22 cents per pound). In 1915 14 rods were dug by hand for \$3.35 per rod, 17 yd. blasted for \$3.10 and 39.2 yd. for \$2.36 per yard.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Unit Stresses for Pipe

SIR: Referring to the article by Barton M. Jones, entitled "Higher Unit Stresses for Pipe and Computation of Water-Hammer Pressure Advocated," printed in your issue of Dec. 30, 1916, page 794, several good points have been brought out by Mr. Jones with regard to the distribution of water-hammer pressure along a pipe and also the need of its computation in design. But on the other hand Mr. Jones' arguments for higher unit stresses hardly seem logical when compared with standard practice in the design of other structures. The term "safety factor" appears to have been misinterpreted.

In all standard specifications on structures the severest loading is required to be used in figuring stresses, and on top of this a safety factor of four, at least, is allowed in the unit stresses for the material in question. Now, in the case of a steel penstock for a hydroelectric development the uncertainties as regards maximum stresses are probably of the greatest. It is not therefore justifiable in this case to cut down the safety factor by the use of high unit stresses, as Mr. Jones proposes, or to use the chance of maximum water hammer as a portion of the safety factor, when in reality it is a danger factor.

In the first part of his article Mr. Jones points out that water-hammer pressures can readily be calculated for any assumed conditions of gate closure, and then later in his article he proposes an inconsistent method for high-head penstocks by the use of the pressure rise due to sudden gate closure for all cases, regardless of the time of gate closure.

This would give results that would be anything but consistent, for in the case of time of gate closure being less than the critical time—that is, the time required for the pressure wave to travel to the forebay and back—the pipe would be stressed to the elastic limit, resulting in a safety factor of two on the ultimate stress. Now on the other hand take the case of time of gate closure greater than the critical time. Your safety factor might be raised to three or four, according to the length of time of gate closure.

In the writer's opinion the only way to get consistent, and yet economical, results is to figure static stress plus water-hammer stress and use a unit stress that gives the required safety factor.

Another point that has been overlooked by Mr. Jones in his argument for higher unit stresses is the fact that a riveted steel pipe when stressed to its elastic limit changes its shape an appreciable amount due to the elastic properties of the metal.

This stretching of the metal if carried to the elastic limit by water-hammer pressure and then allowed to return to its normal size under static conditions will invariably result in a leaky pipe. This is due to the fact that the joint does not act as a unit with the pipe with the result that the calking and riveting of the

longitudinal joints seldom return to their original condition if subjected to any considerable distortion brought about by excessive stresses in the metal.

The statement that "It will be noted that the length of the water column does not affect the calculations except as to what would be termed 'sudden closing,'" is incorrect unless you change "sudden closing" to "gradual closing." Mr. Jones has not made very clear the difference between sudden gate closure and gradual gate closure. For sudden gate closure the time of gate must be less than the critical time—that is, the time required for the pressure wave to travel from the gate to the forebay or reservoir and back—and for gradual gate closure the time of gate must be greater than the critical time.

The method Mr. Jones gives for treating gradual gate closure, while giving accurate results, is long and laborious. Allievius' formula,

$$h = \frac{NH}{2} + H \sqrt{\frac{N^2}{4} + N}$$

where h is excess head in feet, due to water hammer; H , normal static head in feet; N , $(LV/gTH)^2$; L , length of pipe in feet; V , velocity change of water in pipe in feet per second; T , time of gate closure; and g is 32.2 will give accurate results for slow gate closure with much less time and labor.

R. L. HEARN,

Hydroelectric Power Commission of Ontario.

Toronto.

[A copy of the foregoing letter was submitted to Mr. Jones, whose reply follows.]

SIR: The title printed over the article mentioned was somewhat misleading, as the article does not advocate unit stresses higher than are now used on important structures. The practice against which I took issue is the common use of a low unit stress in connection with the static pressure in determining the pipe thickness. as the procedure gives an unbalanced distribution of material. It was proposed that the pipe be so proportioned that at the verge of danger (which may be assumed to be at any particular stress, such as the elastic limit of the material) the stresses will be evenly distributed over all parts of the pipe.

There should be no known relatively weak points at such a time. In this method of design the stress in a pipe is not intended to reach or exceed the elastic limit of the material. However, if by accident it should, a leaky pipe as the result would certainly be preferred to a ruptured one.

With reasonable assumptions, the method outlined by me would give a safety factor of about four. The "severe" water-hammer pressure mentioned, while not specifically so stated, means about twice the estimated maximum water-hammer pressure that would occur, the exact ratio depending on the judgment of the engineer in considering his particular case. If by accident this pressure should occur, the stress in the steel would be

raised to the elastic limit (if such were the figure used in the design), but the pressure could again be doubled before passing the ultimate strength. That is, in this case the estimated maximum stress would be about one-fourth the ultimate. The term "safety factor" is generally accepted as being a measure of the margin between the estimated maximum stress likely to occur and the ultimate breaking stress of the material.

It is true, as Mr. Hearn states, that a steel penstock of a hydroelectric development is subject to the greatest uncertainties as regards maximum stresses. The problem then is to provide for as great shock as possible at a cost within reason. The chance of the stresses becoming double those estimated is about equal to the chance of a defect reducing the strength of a pipe to one-half its estimated ultimate strength. It therefore seems reasonable to divide the margin of safety about equally into an allowance for accidental pressures and for defective pipe; in other words, to cause the allowance for safety factor to act as effectively as possible if it should come into service. This is the main idea of my article.

Evidently a misunderstanding caused Mr. Hearn's second objection, as it was not proposed to design all high-head penstocks for a pressure rise due to sudden gate closure. An illustration was cited where it might be done if desired at less cost than by another method. Gradual closure will produce the same rise in pressure as will a sudden closure of a flow equal to that which is gradually closed off during an interval equal to the critical time. In this manner the sudden closure of partial flow may be used in computing excess head for gradual closure.

It is immaterial whether the term "sudden closing" or "gradual closing" is used in the connection pointed out by Mr. Hearn. The length of the water column determines the critical time, and thereby gives data to distinguish between sudden and gradual closures. A gate closure completed in less than the critical time would have the effect upon pressure rise of sudden closing, while if the time were greater the effect would be that of gradual closure.

As regards the relative time and labor involved in computing simply excess pressure under like conditions it will be shown that the Allievis formula is by far the more cumbersome to use. Upon the assumption, which seems correct, that the ratio of water-hammer pressure for slow closure to sudden closure is as the critical time is to the actual time of closure, the formulas in my article for excess head (sudden closing) and for the critical time T may be used to give the initial or highest pressure due to water hammer for any time of gate closure equal to or greater than the critical time.

Unless affected by extraordinary conditions, such as the irregular action of a governor, the pressure rise cannot exceed its value as computed for the critical time. For the unusual case assumed in the Allievis formula, where the entire length of the pipe is of constant diameter and thickness, the equations will combine and reduce to $h = 11.40Ql/\bar{d}t$, which is equivalent to the usual form $h = 2lv/gt$, in which h is the excess head produced when the flow Q in second-feet, or the velocity V in feet per second, is extinguished at a uniform rate in t , seconds; l is length of pipe in feet; g is 32.2, and d is the inside diameter of the pipe in inches

the notation being different from that used in the article. Neither of these forms, nor the Allievis formula, is applicable when the time of closure, t , is less than the critical time.

It is claimed by some that for slow gate closure the Allievis formula will give more accurate results for water-hammer pressure than those given in my article and upon this basis its use would of course be justified. Under some conditions it will give only half as great pressures as those above, and the results are said to agree well with experimental observations.

In cases of slow closure the pressure at any particular point will commence and continue to rise as the valve closes, until it is affected by the first returning pressure wave. This first pressure rise is not affected by disturbing influences, and its maximum value is subject to reliable calculation. The subsequent pressure waves are so affected by interference that they are far less severe than the initial wave, and unless the pressure of this initial wave is measured, the observed pressures may be misleading, as they will not indicate the maximum that has been reached. The results would lead to the acceptance of the Allievis formula or another, $h = lv/gt$, which is used by some.

It is the initial or highest pressure, the duration of which is too long for its effects to be overlooked, that must be provided for in the design of the pipe. This is the pressure which is considered in my article, and is obtainable from the equations given therein.

Note that a correction in the formula for the velocity of the pressure wave was given in the Engineering Record of Jan. 13, page 57.

BARTON M. JONES,

Division Engineer, Miami Conservancy District.
Dayton, Ohio.

Concrete Institute vs. Joint Committee

SIR: From the account of the convention of the American Concrete Institute, published in your issue of Feb. 17, page 279, it might not be clear just what was done by the Concrete Institute in disposing of the report of the Joint Committee.

The committee for the Concrete Institute on reinforced concrete and building laws made its report to the association, which report was received and ordered to letter ballot. Later the Joint Committee report was brought before the convention and was received and ordered printed. In other words, the American Concrete Institute took the same action on the Joint Committee report as did the American Society of Civil Engineers, and the same action as has been recommended by the masonry committee of the A. R. E. A.

Inasmuch as many felt that the question of discrepancies in the standards, as between the report of the Joint Committee and the committee of the Concrete Institute, should be examined into, later action was taken postponing the letter ballot on the report of the committee of the Concrete Institute for a period of one year. This disposition of the matter seems to the writer to be entirely fair and proper. Whether or not the coefficients of design adopted by the Joint Committee or those recommended by the American Concrete Institute committee represent the more conservative and economical use of materials is a question to be decided upon evi-

dence, derived from several sources—for instance, the logic of mechanics, experience in properly reported service, and experimental investigation.

The writer's view is that both the Joint Committee and the committee of the Concrete Institute used their best judgment in default of clear evidence. It is not known for certain at present which committee report has the greater weight of evidence back of it.

W. K. HATT,

President, American Concrete Institute.
Lafayette, Ind.

Surge-Tank Problems

SIR: Referring to the article by A. G. Hillberg in your issue of Dec. 23, 1916, page 763, Mr. Hillberg has made certain statements which, if allowed to go uncorrected, leave a very misleading impression on the reader.

The title "Surge-Tank Problems Solved by New Methods" is inaccurate, since no solution of the problem is given. What Mr. Hillberg suggests is an arithmetical integration of the surges in a simple tank under change of load. Such arithmetical methods of checking a given design have been made many times to the writer's knowledge. In fact, certain of the recent textbooks on hydraulics illustrate the method.

To illustrate one of the inaccuracies of the article, Mr. Hillberg makes the statement that the effect of friction on the surges in a conduit connected to a standpipe is to diminish the oscillations. "Consequently," he continues, "if no additional change in load occurs, the water level will fluctuate with smaller and smaller oscillations until finally the new level has been attained. To one who has done any work with the simple tank this statement at its face value, without a reference to the effect of governor action, is absurd.

Whether these oscillations for a given load change will diminish is entirely a question of size of tank used on the particular problem studied. As a matter of fact, if the area of the tank is below a certain critical amount and the swelling effect due to the governor action exceeds the damping effect due to the action of friction, the oscillations will increase.

The process of checking any given design by computing the various curves of change of water level in tank, velocity, etc., by the use of small increments of time is so obviously simple that it is strange that it has not been used to a greater extent. The analysis given by Mr. Hillberg is not necessary, since only the fundamental physical laws are used, and such approximations as are introduced by him are not required. He states that higher mathematics is not required in solving these problems and then closes his paper with the suggestions that formulas developed by R. D. Johnson and L. F. Harza be used for fixing the size and obtaining the time of swing of surge. It is rather interesting to note that these formulas have been developed by the use of calculus.

Aside from the accuracy of Mr. Hillberg's analysis, which can be seriously questioned, it appears to the writer that this paper represents a great deal of wasted energy. A far better and safer solution of the troubles incidental to the use of long conduit lines on power-development work is obtained with the differential surge tank developed by R. D. Johnson. This tank offers so

many advantages over the simple tank that no excuse appears to exist for the continued use of the latter.

T. H. HOGG,

Assistant Hydraulic Engineer, Hydroelectric Power
Commission of Ontario.
Toronto.

[As is customary, a copy of this letter was submitted to Mr. Hillberg, and his reply follows.]

SIR: Mr. Hogg was for several years connected with the editorial department of the *Canadian Engineer*, and therefore ought to know that the headlines of articles are not, as a rule, written by the authors. The duty of a headline writer is to catch the reader's interest and to make him read the articles. Mr. Hogg has undoubtedly many times, in the past, not only given articles new headlines, but, also, rewritten the first paragraph in order to, so to say, "lead the reader on." When my article was submitted it was modestly headed "Surge-Tank Problems," so that it is not fair to hold me responsible for the headline as printed.

Mr. Hogg's statement that the method outlined has been published in recent textbooks is a surprise, as the writer is unaware of it.

The statement that the friction tends to diminish the surges is correct, but the question of governor action was not considered for several reasons in the article in question. First, the wheels used under relatively high heads are Francis turbines of low specific speed, or impulse wheels. For the latter type the drop in efficiency is very small and its influence on the flow in the penstock negligible, especially when a deflecting nozzle is employed.

For Francis turbines of low specific speed the drop in efficiency for gate openings over 0.8 is less than that for wheels of high specific speed, so that the "fanning" influence of the governor is less in the former case than in the latter.

As a power plant always has more than one unit, and as load charges will be distributed on all the units operating at the time, the change in their efficiency will be very small, so small that the "fanning" action of the governor can be neglected. Furthermore, it is seldom that a surge tank is designed for a change in load of more than 25 per cent, as greater variations are unlikely to occur except in extreme emergencies.

However, Mr. Hogg is correct in stating that if the area of the tank is too small, the action of the governor might become serious under certain extreme conditions. If, in the method described in my article, it is desired to take into account the fluctuations in efficiency of the wheels at different gate openings, this can easily be done by figuring the discharge required under the average head prevailing during a given interval of time and increasing or decreasing the penstock velocity a corresponding amount.

The writer suggested the use for preliminary investigations of the formulas developed by Strickler, Johnson and Harza not because it is necessary to use them but because of the convenience and saving in time.

Mr. Hogg concludes his letter by advising engineers to drop the use of the single tank and adopt the Johnson differential tank. The writer agrees with Mr. Hogg that the differential surge tank is admirably adapted for damping surges effectively, but unfortunately it cannot

always be applied. A few months ago the writer designed a development where the conduit was about 30,000 ft. long and the gross head 345 ft. The losses in the long conduit amounted to about 50 ft., and in addition the fluctuation in level of the storage reservoirs was 90 ft.

To build a differential surge tank to meet these requirements would have been difficult, and finally a surge tank to be blasted out of the rock was proposed. This tank will be provided with large chambers at its upper and lower ends connected by a shaft of 10 x 10-ft. cross-section.

Mr. Hogg is located in Canada, where there are no patents on the Johnson tank, and where everybody who feels so inclined can design and build as many as he likes. In the United States, however, the patents on this tank are very strong, and, consequently, the additional cost of the royalty has to be considered.

A. G. HILLBERG,
Hydraulic Engineer.

New York City.

How to Melt Lead from Joints of Water Line

SIR: In your issue of Dec. 23, 1916, page 779, Harry Watts asks regarding melting lead from the joints of a 24-in. cast-iron water line.

The writer has had occasion to remove a considerable amount of cast-iron pipe with lead joints, and has also experimented with a gasoline blow torch and other devices for using a local flame to heat the lead, all of which he found absolutely ineffective. In removing a 48-in. line and several smaller lines the only really satisfactory method found was to excavate a bell hole beneath the joint and build in it a wood fire. This is probably the cheapest and best method that could be used.

However, the acetylene torch had not been developed at the time this work was done. Recent work done with the torch would lead the writer to believe that it could be successfully used. There is serious doubt in his mind, however, as to whether the wood fire would not, after all, be very much quicker and cheaper.

J. H. WEATHERFORD,

Memphis, Tenn.

City Engineer.

SIR: Referring to the inquiry of Mr. Watts relative to taking up cast-iron water mains, during the past season the writer had a contract for water-main extensions which included the taking up of 500 ft. of 8-in. and 2000 ft. of 4-in. cast-iron pipe. The oxyacetylene flame was used to melt the lead out of the joints. For experiment a gasoline and also a kerosene flame were tried, but were too slow.

The pipe was uncovered and a small bell hole dug at the joint to be melted. (Eight-inch pipe were taken out two lengths and 4-in. pipe three lengths at a time.) This bell hole was just large enough to permit the torch to play around the entire joint. A small derrick was placed over the open end of the pipe, and the line to the derrick hooked to the bell or open end of the pipe. The pipe was raised several feet and blocked. The derrick was then moved to the center of the pipe and the line to the derrick fastened around the pipe and the blocking removed. While the pipe was thus swinging it was unjointed by pulling with a long bar. This

bar was set alongside the pipe and fastened to it with a chain in such a manner that when pushed forward a slight turn was given to the pipe, which helped to unjoint. A small hole in the ditch served as the "bait" for the bar. Two men worked the bar.

When all the lead was removed from the joint the unjointing of the pipe was easy, but if only a very small piece was left, it was necessary to drive it back with a yarning iron before the bead on the end of the pipe would pass through the bell. The jute also would jam around the bead and cause trouble.

When the joint was hot it came apart much easier than when cold, especially if a small piece of lead was left. This piece of lead seemed to be more pliable and would flatten out enough to allow unjointing, and the jute as soon as exposed to the air would start to burn.

Antigo, Wis.

HENRY OLK,
Engineering Contractor.

SIR: In regard to suggesting a good method of melting the lead from the joints of a water line, we have had occasion to take up mains and find the following method to work out to good advantage:

After getting the pipe uncovered we take a pipe cutter and cut off the pipe ahead of the bell so that we can raise three or four lengths of pipe out at once and melt the lead out of the two or three joints, depending on the lengths taken out at a time. When the pipe is laid on top of the ground, this may be done by a fire, blow torch or carbide outfit.

Unless you start from a dead end it will be necessary to make two cuts to get the first section out. After that only one cut is necessary. On every joint cut you will lose a small section of the pipe, but the loss is overcome by being able to melt the lead on top of the ground instead of working in the ditch, and by being able to raise three or four lengths out of the ditch at one time.

Marshalltown, Iowa.

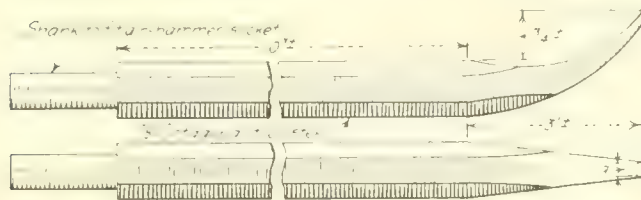
W. H. STEINER,
City Engineer.

SIR: The writer had to take up about 1200 ft. of 30-in. cast-iron gaspipe with yarn and lead joints. Oxy-acetylene apparatus was tried, but one of our assistant general foremen, who was in direct charge of the work, under the writer, believed that the progress was not sufficiently fast and that better results could be obtained by using a pick-out tool in conjunction with a gas-driven air compressor.

This man designed a pick-out tool like that shown in the accompanying sketch, and the results were exceedingly satisfactory. It was found that almost twice as much speed was obtained with this tool as with the oxyacetylene apparatus.

The reason for this difference the writer believes to be as follows: On pipe sizes from about 16 in. up, the slope of the sides of the pipe is not sufficiently steep to permit the rapid flowing to the ground beneath of the melted lead from the joints, hence this melted lead, which cools rather quickly, piles up in a lump on either side of the melting torch, and has to be burned away piecemeal. Even though the burning out of the joint is begun at the extremities of the horizontal diameter,

this condition holds good at a short distance above and below either extremity of that diameter. The difficulties increase as the torch is entered deeper into the bell of the pipe. With the pick-out tool, however, it was possible to enter the tool easily to a depth of from $\frac{1}{4}$ to $\frac{1}{2}$ in. and follow around the circumference of the



PICK-OUT TOOL TO BE DRIVEN BY AIR COMPRESSOR

The dimension a should be about two-thirds the width of the joint in the bell, or the distance between top of spigot piece and inner periphery of hub.

joint for quite an arc length, poking the lead out and away in a long thick ribbon, much as a carpenter would make a cut in a soft pine board with a chisel, using a hammer in place of the air pressure.

R. C. KELLOGG,

Brooklyn, N. Y.

Civil Engineer.

Filtration, the First Line of Defense

SIR: Your editorial of March 10, page 370, dealing with the water-purification problem of the city of Milwaukee and the recommendation of the United States Public Health Service to construct a water-filtration works, is to be commended. I believe, however, that it would have been more equitable to mention the results that have been accomplished by the application of liquid chlorine to that supply than to speak of the results that have not been accomplished. I cannot agree with you that chlorine in quantities below the complaint point will not make a water safe. It is entirely a matter of distribution. If to each unit of water is distributed its proportionate amount of liquid chlorine, satisfactory bacteriological results will be obtained, and very seldom at the expense of the physical characteristics of the water.

We agree whole-heartedly with you that the filtration of any heavily polluted water supply is desirable. We have maintained, and have so indicated in all our literature, that chlorination is not a substitute for filtration; for although chlorine will render any water supply safe to drink, it will have very little effect on turbidity or color, and although chlorination should be used as a safeguard for every water supply, irrespective of its source, it should very frequently be used to supplement filtration.

The value of liquid chlorine in the field of water purification needs no exposition here. The number of lives that have been saved, the water supplies that have been made safe for domestic use and the marked decrease of the typhoid-fever rate in practically every case where chlorine has been adopted are sufficient testimonials of the value of the process. Complaints of unsatisfactory treatment and of tastes and odors when liquid chlorine is used are fundamentally due to improper and uneven distribution of the chlorine in the water to be treated.

WILLIAM J. ORCHARD,

Sanitary Engineer, Wallace & Tiernan Company,
New York.

SIR: While I heartily agree with most of the statements made in your editorial of March 10, entitled "Filtration, the First Line of Defense," still to others it may be somewhat misleading. It happens that I was instrumental in having installed at Milwaukee a chlorine plant which, it seems, has not, with entire success, been able to cope with the situation prevailing there, and I am sure that no one will welcome more sincerely than I the filtration which is recommended and doubtless much needed.

Milwaukee's water supply is a most difficult one for chlorination to safeguard unaided, apparently because of a high organic content and the unusual chemical characteristics of the water which tend to neutralize the sterilizing agent and diminish the efficiency of its action upon disease-producing bacteria. Although I have installed chlorination plants in hundreds of cities and towns in the past few years, I cannot recall another city which presents greater difficulty for chlorination used without any other measure of purification. However, I believe that your editorial tends to ignore, or at least minimize, the results accomplished with chlorine in the face of these difficulties.

Chlorination at Milwaukee by hydrochlorite of lime began in 1910—an epidemic year—and was followed by the application of liquid chlorine in 1914. I regret that I have not the typhoid mortality rate during 1916, but during the first five years of sterilization the results with the chlorination process were as follows:

Year	Typhoid deaths per 100,000
1910.....	45
1911.....	37
1912.....	26
1913.....	11
1914.....	8
1915.....	4½

Were this merely an isolated case of consistent mortality reduction, due to chlorine, then I would have no occasion to comment upon your editorial; but the results actually accomplished in numerous cities certainly lift chlorination out of the category of "emergency and factor-of-safety" measures. Just offhand I can name several towns whose typhoid death rate has become zero with the introduction of liquid chlorine treatment—for instance, Alpena, Mich.; St. Catharines, Ont.; Logansport, Ind., and Ossining, N. Y. Typhoid deaths have been unknown in these four towns since chlorination, over a period averaging more than two years. The combined population of these towns is 60,000, and previous to chlorination they had a combined typhoid mortality rate of 46 per 100,000. Would you call this "emergency" accomplishment?

I will not tire you with further statistics, but will merely remind you that a substantial and progressive decline in typhoid mortality has invariably followed the introduction of chlorination even when the sole protection is this "emergency measure"! (See records of Sacramento, Buffalo, Utica, N. Y., Tacoma, Wash., and Wilmington, N. C.) And when filtration is in operation previous to chlorination, and records over a sufficient period for accurate determination of the mortality rate are available, there is, as a direct result of this subsequent chlorination, a consistent, and I might safely say an invariable, decline in typhoid mortality

below its previous minimum, with a uniform tendency to continued decline. (See records of Kansas City, Denver, Philadelphia, Wilmington, Del., St. Louis, and Paterson, N. J.)

I do not want you to set this letter down as a bit of special pleading, for I have not the slightest desire to minimize in any way the importance of filtration as "permanent construction." I would consider myself most unworthy if I should neglect any opportunity to recommend filtration whenever a community can afford it—and few cannot when its value is realized.

But at the same time I am confident that a brief study of the records of the cities named, and others, may perhaps influence you in a future editorial to consider chlorination more nearly in its true relation to the problems of water supply—as an integral part of the permanent construction.

JOHN A. KIENLE,
Assoc. M. Am. Soc. C. E.; Sanitary Engineer, Electro Bleaching Company.
New York.

Another Test Discredited

SIR: As a member of the Committee of the American Society for Testing Materials on Distillation that put forth the present accepted distillation test on tar, I must emphatically protest against the publication of such pseudo science as is given in your editorial of March 10, page 369, entitled "Another Test Discredited."

Any such deductions as you have drawn from the paper by Messrs. Reeve and Anderton are entirely unwarranted by the facts. I am sure that no one would be more quick to say so than the gentlemen themselves. Their work proves beyond question the great value of the distillation test, and the mere fact that the tars of such varied origin do not group themselves in the same order by the distillation and by the weathering test was only to be expected. All work previously done on tars would point conclusively to the same results.

The distillation test is only one of a number of tests used in valuing tars. They cannot be used separately, but must be judged in their interrelation, one to the other. It would be just as logical to judge an asphalt by the penetration test alone, and to say, since a series of asphalts did not group themselves in the same way when their insoluble residues were determined, that therefore the penetration test was of no use.

What the Office of Public Roads thinks of the distillation test is perhaps best shown by the specifications issued by the Office of Public Roads. All tar specifications contain the distillation test. The form specification for approval by the state highway departments recently considered in Washington at a meeting of state highway engineers also gives the distillation method under tar specifications.

In fact, the distillation test, instead of being a discredited test, is very much of an accredited test, and I am surprised that the Engineering Record should be so led astray in a matter so easily verified.

PHILIP P. SHARPLES,
Manager, General Tarvia Department, The Barrett Co.
New York City.

[Copy of this letter was submitted to Charles S. Reeve, chemist, U. S. Office of Public Roads, whose reply follows.]

SIR: Your letter of March 16, with inclosures calling attention to an editorial and correspondence relating to a paper on "The Effects of Exposure on Tar Products," by B. A. Anderton and the writer, were duly received. We were at the same time in receipt of a letter from Philip P. Sharples, submitting a copy of his views as expressed to the editor of the Engineering Record. Appreciating the sincerity of all parties to the controversy, I believe that a statement on the part of the authors of the paper under discussion is in order, to make clear their position.

A careful review of the paper and editorial in question would indicate that the editor has made a broader interpretation of the idea which the authors attempted to convey than is warranted by the data and conclusions. The writer of the editorial in question is justified in his conclusion that the distillation test gives no data on tar products which can be directly correlated with the behavior of these same tar products under service conditions. The authors clearly indicated this in conclusions 1 and 4, which are as follows:

1. Upon exposure to service conditions tar products materially harden to a much greater extent than can be attributed to loss of distillate alone.

4. The comparative consistency of pitches obtained from distillation of tars to a single arbitrary temperature does not represent the relative behavior of the tars in service.

It will be noted that both clauses specifically refer to the relation between distillation results and service results, but the editorial would give the impression that the distillation test has been entirely discredited. In doing so it does clearly misinterpret the intent of the authors.

The authors do not feel that the data submitted by them have proved beyond question the great value of the distillation test, but this test will no doubt continue to be an essential one for aiding in the determination of the source, quality, and acceptability of tar products. The writer, with Mr. Sharples, as a member of a subcommittee on distillation of the American Society for Testing Materials, investigated and recommended the standard test now generally accepted, and will continue to indorse the inclusion of a distillation requirement in specifications. The distillates serve to assist in identifying the type of tar, and must necessarily be obtained if an effort is made to prove or disprove the addition of petroleum or asphalt products. The consistency of the pitch obtained from distillation, while it does not indicate the consistency to be expected from tars when exposed to service conditions, will assist in determining the quality and character of the product in so far as its method of preparation is concerned. It is for the latter reason that a melting-point requirement was included in the distillation clause of the form of specification recently recommended by the Conference of State Highway Testing Engineers and Chemists. The authors, as members of the conference, coincided in indorsing such a requirement.

The foregoing discussion should serve to make clear the conclusions of the authors, which indicate lack of direct relation between distillation values and service results, without any intention of discrediting the use of the distillation test as a specification requirement when its purpose and value are correctly understood.

Owing to the fact that the authors are daily in receipt of letters calling their attention to this editorial and asking an expression of their views regarding it, they trust that the above discussion may be given sufficient prominence to make clear their position in the matter.

CHARLES S. REEVE,

Chemist, Office of Public Roads and Rural

Engineering.

Washington, D. C.

[The Engineering Record desires merely to point out that identification tests, such as the distillation test undoubtedly is, have their value, but should be placed in a separate category from definitive tests. They are, after all, only an explanation, in technical terms, of the title of the specification, and should in no sense be considered as a measure of use-value. Reference to the editorial in question should suffice to demonstrate that the attack was made upon the distillation test as a measure of the ability of a tar to resist changes following upon exposure. With this position Mr. Reeve seems to be in agreement. It is unfortunate that writers of specifications do not always differentiate more clearly between those tests which are only intended to identify a material and those which are expected to measure its value.—EDITOR.]

Locating Neutral Axis of Roof Purlins

SIR: In connection with Mr. Fleming's article in the Engineering Record of March 3, page 347, on the design of steel purlins, I inclose a graphical method for locating the neutral axis when the plane of the bending moment is not parallel to a principal axis of the purlin.

Assume a 10-in. 15-lb. channel purlin on a roof with 15-deg. pitch. The compression at the point a due to the moment $M \sin \alpha$ is found to be $0.221M$, and the tension due to the moment $M \cos \alpha$ is $0.072M$. On the line ca lay off cd = 0.221 to any convenient scale and draw od. On the axis 2-2 lay off 0.072 to the same scale. Draw fe parallel to the axis 1-1, and eh parallel to 2-2. Then the line NN through h and o is the neutral axis.

The correctness of this method is easily proved. As all points on the line ca are subjected to a compression of $0.221M$ due to $M \sin \alpha$, and the stress varies as a straight line, all points on the line eh parallel to 2-2 are subjected to a compression of $0.072M$ (by similar triangles), and this equals the tension along the line ab due to $M \cos \alpha$. Therefore at the intersection of eh and ab there will be no stress, and this point lies on the neutral axis.

The writer made use of this method several years ago in some similar work, and it may be of interest to your readers.

LEROY W. CLARK,

Assistant Professor of Mechanics, Rensselaer Polytechnic Institute.

Troy, N. Y.

[It is evident that the point h could be located by computing the ratio $0.072/0.222$ times the distance from

a to axis 2-2; furthermore, it is a question whether the simple formula for angle θ given by Mr. Fleming would not be sufficient and save time. A complete graphical method for locating this neutral axis is given in the Hütte handbook, page 387 of the 1905 edition and page 530 of the 1915 edition.—EDITOR.]

Fills Under Concrete Roads Should Be Seasoned

SIR: I have read with interest the good points in concrete road building being brought out in your recent issues, and I wish to call attention to one subject I have not seen discussed, but which is of vital importance on this work.

Most specifications provide for rolling in thin layers of all deep fills, but even when conscientiously done the fresh fill is not fully settled when the work is completed and accepted. The final shrinkage of the filled material was not noticeable on macadam roads, but the large and plentiful cracks to be found in almost all concrete slabs over deep fills indicate a "haste that wastes." I believe that, after all the customary precautions to obtain dense fills have been taken, the roadway should be opened to traffic and seasoned for a winter before laying concrete. Where such fills constitute only a small part of the work, the slabs may be omitted over deep fills and enough broken stone spread to provide a passable road until spring, when the remainder of the pavement may be poured. This stone, when spiked and rolled, provides an ideal foundation for the concrete pavement where such reinforcement is most needed.

This seasoning of fills may not be as convenient as rushing the work to completion in one season, but will remove all the weak points in the present practice of concrete road construction, and make for better roads and real economy.

E. EARL GLASS,

Los Angeles County Road Department.

Monrovia, Cal.

A New Attitude Toward Road Building

Instead of constructing annually a few miles of disconnected hard surfaced road, Ogle County, Illinois, expects to indulge in a wholesale road-grading program, the cost of which will be reduced to a minimum by letting the work in large contracts. The size of the work undertaken will justify the contractor in providing an ample plant and hiring the most competent labor—a thing which is rarely possible in small undertakings. At the same time, permanent bridges and culverts will be constructed. This plan is recommended because it is found that the present method of permanent though disconnected improvement was unpopular, since it did not result in enough general benefit. On the other hand, the proposed system is warmly approved, particularly as it relieves the township of the necessity of caring for the unimproved roads over which perhaps 75 per cent of the travel passes. The plan gives the county a complete system of well-constructed roadbeds with seasoned embankments ready for a hard surface whenever the volume of travel warrants it and the funds are available. The cost is to be met by issuing short-term bonds, and the total necessary will not strain the county's financial resources.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Oval Gravity-Return Track Used to Feed Aggregate to Mixer

By W. R. HOWARD

Assistant Superintendent, Ferro-Concrete Construction Company, Cincinnati, Ohio

A SHORT inclined track elevator set on one side of the mixing plant in an oval track on which aggregates were delivered in small cars was used with great success by the Ferro-Concrete Construction Company in building the new five-story plant of the American Tool Works at Cincinnati, Ohio. On account of the size of the building, the lot being 250 by 260 ft., and the location on the railroad siding, as shown in the photograph, it was desirable to place the concrete mixer and tower in the center of the lot at some distance from the unloading point and storage bins.

In order to supply the mixer with materials and still avoid using a greater number of laborers, the oval gravity track shown in the photograph was laid out. This 2-ft. gage track was arranged so that a car on leaving the mixing platform ran by gravity to the material bins, where it was checked by two men who filled

it with stone and sand, and then released and allowed to run by gravity to the foot of the incline on the opposite side of the mixing plant from which it had started. Here it was elevated again to the mixing platform by an endless chain with projections engaging the axle of the car, which was run by an oil engine. This engine was belted to the drive shaft of the chain so as to reduce the speed of the latter to about 60 ft. per minute. The incline was about 40 ft. long.

On reaching the mixing platform the contents of the car were dumped into the mixer hopper, where the cement was added. The cement was unloaded from the cars by hand, and delivered to the charging platform on gravity rollers. Sufficient space was provided on the platform to store cement for one day's run, which required, on the average, about 1500 sacks.

The total quantity of concrete to be placed by this plant is 12,000 yd. Its cost so far, for mixing only, not including unloading or hoisting and placing, is estimated at about 17 cents a yard. The work on which this plant was used was in charge of A. E. Hodges, superintendent for the contractor, under whom the writer was assistant superintendent.

"H E'S a darn good man," says the Big Boss, "an' I think we want him."

"An'," says his general super, "howdjer know that? Ye've never even seen him."

"I don't have to," replied the Old Man. "I know enough about what he can do fr'm readin' all the write-ups on his work in

HINTS FOR THE CONTRACTOR



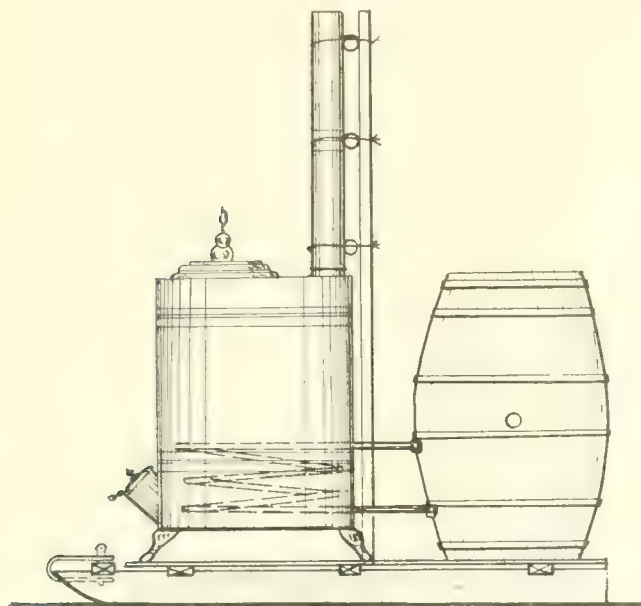
OVAL TRACK WITH CAR ELEVATOR MADE IT POSSIBLE TO SHORTEN SPOUTING BY PLACING TOWER AT CENTER OF LARGE BUILDING

Mount Old Stove and Barrel on Sled to Make Portable Water Heater

By EARL D. COVELL

Constructing Engineer, Missoula, Mont.

A PORTABLE water heater used very successfully by the writer in building small concrete structures for irrigation canals of the U. S. Reclamation Service is shown in the sketch. As the structures averaged between 6 and 10 cu. yd. of concrete each, it was necessary



HEATER USED FOR SCATTERED JOBS AVERAGING LESS THAN 10 YARDS OF CONCRETE EACH

to have some means of heating the water that could be moved easily and quickly.

The heater built consists of a common sheet-iron heating stove inside which was fitted a coil of 1-in. black iron pipe with three turns, the ends of which were fastened into the sides of the water barrel with lock nuts. The stove and barrel were wired securely to a stone boat. When the concrete mixer was moved from place to place the heater was pulled along behind with ease.

A similar arrangement was also used for heating water in making concrete pipe in an enclosure during winter months. The cost of securing hot water with this rig was reduced to a minimum by using scrap pieces of form lumber.

The Elusive Cement Sack Again

By F. C. YEATON

Oak Park, Ill.

WHILE the clever ditty blaming the Polak, Dago, Hunkie and Ginny for the disappearance of cement sacks, published on page 400 of the Engineering Record of March 10 last, is undoubtedly justified by fact, still it should not be forgotten that many hundreds, or even thousands, of sacks are lost through the carelessness of the contractor himself.

For instance, on a certain construction job a storehouse nearly full of sacks was destroyed by fire without the possible salvage of a single sack. One month

later, a tent erected in its stead, and containing a thousand sacks, was washed away by high water over night.

Contractors habitually erect their storage houses for sacks with little thought for their safety from such accidents, in spite of the fact that one fire or flood may destroy enough sacks to cost the contractor a large part of his entire profit on the job.

Jointed Pipe, Cheaper Than Steam Hose, Saved Delay in Getting Latter

By H. W. STREULI

New York City

ON A SMALL JOB requiring the driving of only 15 piles, the operation of the fairly heavy steam hammer used would have required at least 25 ft. of 1½-in. steam hose, since it was necessary to raise and lower the hammer through nearly 20 ft. As there was no hose of this size on the job, and as it could have been obtained only after a delay of three or four days at a cost of \$30 or \$40, it became necessary to devise a substitute. Three pieces of old 1½-in. pipe were connected together with four short nipples and eight el-



OLD PIPE FITTED WITH SWING JOINTS SAVES PRICE OF STEAM HOSE AND CONSIDERABLE DELAY

bows, as shown in the illustration. This constituted a steam line with all the necessary flexibility, at little cost for materials, since the pipe and fittings were already on the job. Some of the strain was taken off the joints by means of a rope.

Where Is the Money Coming From?

The increase in revenues devoted to the construction of roads in Maryland between 1904 and 1909 amounted to 586 per cent. Delaware ran a close second, with 463 per cent increase. While Arkansas devoted only 9 per cent of her revenues to the construction of roads, the average increase for the Southern states for this period amounted to 143 per cent.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

More Engineers Appointed to Officers' Reserve Corps

Engineers' Company Steadily Growing
—Necessary to Restrict Applicants
for Major's Grade

The following recent appointments to the Engineer Officers' Reserve Corps supplement the lists that appeared in the Engineering Record of March 3, page 363, and March 17, page 445:

Majors—Rukard Hurd, Minn.; Paul Doty, Minn.; Walter L. Webb, Pa.; Jenks B. Jenkins, Md.; William J. Wilgus, N. Y.; William H. Herron, Washington, D. C.; Robert B. Marshall, Washington, D. C.; Austin C. Harper, N. Y.; Frederick J. Wood, Mass.; George E. Verrill, Conn.; F. W. LaForge, N. Y.; William B. Harrison, Washington, D. C.; A. M. Walker, Washington, D. C.; J. H. Jennings, Washington, D. C.; G. T. Hawkins, Washington, D. C.; Fred I. Wheeler, Ohio.

Captains—A. Stellhorn, Canal Zone; J. S. Herbert, Pa.; J. W. Skelly, Mo.; H. W. Hudson, N. Y.; J. D. Irving, Conn.; A. B. Searle, Washington, D. C.; E. H. Ropes, Washington, D. C.; E. B. Butchers, Pa.; F. W. Green, Mo.; W. L. Miller, Washington, D. C.; H. J. Stehli, N. Y.; J. F. Barber, Pa.; Charles B. Stanton, Pa.; Robert B. H. Begg, Va.; Charles T. Osborne, Mo.; Harrison V. Pittman, Mo.; Clyde C. Elmes, Pa.; Maxwell W. Smith, Ill.; Percy James Wilson, Mass.; Fred. E. Foster, Mo.; George T. Street, Ohio.

First Lieutenants—Henry Taylor, Pa.; L. C. Josephs, Jr., N. Y.; E. L. Bandy, Washington, D. C.; Robert Boettger, N. Y.; Warren Gardner, N. Y.; T. C. Thogerson, Mo.; H. L. Haverstick, Pa.; L. S. Leopold, Pa.; S. Steenerson, Minn.; John Ross Eakin, Washington, D. C.; Luria Lyons Lee, Washington, D. C.; R. B. Carver, N. Y.; E. L. Hain, Washington, D. C.; Harry V. Newcomb, Mo.; Frank W. Hamilton, Conn.; John E. Terhune, N. Y.; Evan William Scott, Va.; James F. Ryder, Mass.; A. S. Mirick, N. Y.; E. D. Hendricks, N. Y.; T. H. Moncure, Washington, D. C.; Seth William Webb, Ohio; Samuel H. Brooks, Mass.; Frank T. Leilich, Pa.; Gordon H. Fernald, Mass.; B. D. Barker, Ill.; F. Miller, Mass.; Theodore Belzner, N. Y.; A. E. Crane, N. J.; F. N. Wildish, Ill.; R. William Queal, Mo.; John G. Kelly, Jr., Ore.; Robert W. McLean, Mass.; Louis N. Sperry, N. Y.; A. D. Stoddard, Mo.; J. R. Armington, Pa.; Alexander A. Laird, Tex.

Second Lieutenants—L. D. Coles,

American Railway Engineering Association Adds Much Material to Its Manual

Cut and Screw Spikes, Ashpits, Freighthouse Scale Location, Wall Formulas, Concrete-Pile Design, Surface Finish, Embankment Shrinkage Are Subjects Discussed

Despite the absence in Washington, because of the conflicting valuation hearing, of a number of familiar faces, the American Railway Engineering Association's convention in Chicago, March 20, 21 and 22, was able to enroll nearly its usual number of railroad officials. At the Appliance Show the attendance (22,352) even exceeded that of former years.

The Committee on Grading of Lumber was honored with a crowded roomful, and a spirited discussion arose over the proposal to limit treatment to dense Southern pine only. While the convention conceded that concrete for trestles was better than timber in most ways, it would not agree to the definite figure proposed by the Committee on Wooden Bridges and Trestles.

A. S. Baldwin's presidential address called attention to the added usefulness of the *Manual*, a canvass of roads indicating that the standards and specifications are gradually bringing about a general unification of practice. The extent of military preparedness, the prediction that the Interstate Commerce Commission valuation would be completed by Jan. 1, 1920, and co-operation with other engineering societies in Chicago for the purpose of getting a home for all, as proposed recently by the Chicago Engineers' Club, were subjects discussed by Mr. Baldwin.

Wooden Bridges and Trestles.—Strenuous objection was made to the definite statement that creosoted timber trestles are more economical than concrete when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure. Formulas were given showing the comparative economic value of the two types. Two tables, assuming a life of twenty or twenty-five years for the timber and from thirty to one hundred years for the concrete, were made up showing comparable costs per linear foot for each. The committee contended for these that they were examples only and the engineer could use his own estimates.

Discussion of Reports

J. G. Sullivan (Canadian Pacific) objected to the use of a sinking fund at 6 per cent on the ground that banks will not pay so much. A. F. Robinson (Santa Fé) felt that there should be a restriction as to the height of timber trestles. If more than 20 ft. the fire danger is greater and much time is necessary to rebuild.

E. A. Frink (Seaboard Air Line) of the committee explained that the 1:1½ ratio was only a rough approximation and applied to trestles under 23 ft. high.

Hunter McDonald (Nashville, Chattanooga & St. Louis) called attention to conditions where drainage may permit trestled crossings to be filled and a long-lived concrete trestle could not be recovered. In other places floods make necessary the lifting of the whole roadbed every few years because of the filling in of material. Under these conditions it is a mistake to build too permanent a structure; there would be more risk of loss—non-recovery—with a concrete structure.

Conclusions Adopted

After several speakers gave information as to the cost of trestles and the small maintenance of both types, Mr. Frink stated that the conclusions were purely mathematical and not based on data collected. This one conclusion was voted down, but others relating to fire hazard, stability against the action of floods, service qualities, appearance and conservation of materials were adopted.

Stresses in Railroad Track.—Prof. A. N. Talbot reported progress only for this special committee co-operating with

To Subscribers for the Engineering Record and Engineering News

Subscriptions for the Engineering Record and Engineering News will be continued automatically as subscriptions to the Engineering News-Record, effective with this issue. Where both papers have been subscribed for, the unexpired terms of the two subscriptions will be added together and applied on the Engineering News-Record. In other words, readers will get for the unexpired terms of their subscriptions the greatly increased value that will result from the consolidation of the two papers.

a similar one of the American Society of Civil Engineers. He stated that tests indicate that stresses 18 or 20 in. below the tie become nearly uniform in a direction parallel to the track.

Track.—Specifications for cut and screw spikes, which have been before the association for some time, were adopted with a few minor changes. Earl Stimson (Baltimore & Ohio) objected to the form proposed on the ground that it was not possible to make the spike in the present automatic machines, although they could be made in hand machines. Manufacturers have assured the committee, however, that the new spike can be made automatically.

H. R. Safford (Grand Trunk), vice-chairman, asked to change the figures under "physical properties and tests" to read "elongation not less than 25 per cent in 2 in., or if test is made on bar, 20 per cent in 8 in." because the percentage of elongation is greater for short specimens than for longer ones.

Ballast.—The order in which various materials are considered best was left as the committee set them down when the word "about" was used as a qualifying term and it had been explained that this order referred to the best quality of each.

J. L. Downs (Illinois Central) stated that there was a marked difference between a pit-washed gravel and a river-washed gravel, because the former was sharp-grained and the latter round-grained.

R. H. Ford (Rock Island) contended that a sub-ballast cinder blanket of cinders of less than 12 in., even down to 4 in., had been found effective in preventing mud from working upward, but the convention approved the committee's 12-in. recommendation. Mr. Ford's arguments against the adoption of a standard class A ballast section to the effect that only good practice can be laid down were concurred in and all four sections submitted were referred back to the committee.

Roadway.—The expected discussion on the allowances for anticipated shrinkage in embankments did not materialize and many important recommendations of the committee were adopted without comment. These include recommendations intended as guides in the selection of equipment, material-handling, blank forms for reporting operations of equipment, shrinkage percentages and conclusions as to depressing or elevating streets where a few crossings are to be eliminated.

Yards and Terminals.—This committee's recommendations also went through with little discussion. They included the three hump profiles for gravity yards in cold, moderate and warm climates respectively.

Buildings.—The committee presented definite conclusions on freight-house scales, which were adopted although C. E. Lindsay (New York Central) felt that more than from 6 to 8 ft. should be left between the side of the house and the scales to prevent congestion.

After striking out a sentence referring to the 5-ft. depth of water in ash-

pits, the committee's recommendations on ash pits were concurred in. There was some discussion on the question of safety protection to prevent men from falling into the pits. As four men have been drowned on the Baltimore & Ohio, M. A. Long of that road, chairman of the committee, held to the recommendation for rails on the sides and inclines at the ends.

Grading of Lumber.—While the proposed specifications for Southern yellow-pine bridge and trestle timber to be treated were referred back to the committee, the discussion on the question of quality was one of the most spirited of the convention. Mr. Frink led the discussion and was armed with a large sheaf of correspondence expressing a wide diversity of opinion from officers of railroads, lumber companies and creosoting plants as to the admission or not of loblolly and shortleaf pine. He argued that if loblolly was weaker, more of it, if treated, could be used, and that the reliance of the committee on a treated envelope around the heartwood of dense pine was not, in the opinion of many, entirely effective. He would accept all three pines.

Dr. Hermann von Schrenk, chairman of the committee, explained that the restriction to dense Southern pine was to have the highest type of standard first, inasmuch as the treatment refers only to bridge and trestle timbers, stringers and sills. It has nothing to do with the treating of piles for teredo protection. Mr. Frink replied that the reason the present specification calls only for dense pine is that loblolly is not so durable.

The Committee on Grading of Lumber asked that the Committee on Wooden Bridges and Trestles give it a clear understanding as to what timbers it would consider in a first-class bridge.

Masonry.—With a change in name from precast to premolded, specifications for concrete piles of this type were accepted.

Prof. H. S. Jacoby brought up the question of artificial seasoning when the clause calling for twenty-eight days before using was under consideration. The phrase "under normal conditions" was finally added and the time allowance left to the engineer when artificial means are used.

Specifications for driving premolded piles were acceptable with minor changes, but were referred back to the committee to bring in another year with the drawings to which they referred.

L. N. Edwards, engineer of bridges, Toronto, objected to washing surfaces with water after the desired finish is obtained, holding that too much cement would be washed off and that it left the surface more open to future disintegration. F. L. Thompson (Illinois Central), chairman of the committee, explained that unless the surplus is washed off it will flake. The surface finish specifications were then passed.

The joint committee specifications for Portland cement were adopted, as were those for natural cement, which are

simply rearranged from the present requirements in the *Manual*.

R. L. Humphrey, consulting engineer, explained that the requirement for specific gravity was left out of Bulletin 194 unintentionally.

Rules and Organization.—There was considerable doubt last year as to what was adopted as a minimum clearance diagram. The committee's work of reconciling the conflicting dimensions with the previously adopted third-rail clearances for electrified roads was approved.

Officers

The officers elected for the ensuing year are as follows: President, John G. Sullivan, chief engineer, Canadian Pacific; vice-presidents, C. A. Morse, chief engineer, Chicago, Rock Island & Pacific, and Earl Stimson, engineer maintenance of way, Baltimore & Ohio; treasurer, George H. Bremner, district engineer, Division of Valuation, Interstate Commerce Commission; secretary, E. H. Fritch; directors, J. A. Atwood, W. H. Courtenay and L. A. Downs; members of nominating committee, J. R. W. Ambrose, George H. Burgess, W. M. Dawley, V. K. Hendricks and S. T. Wagner.

To Investigate Leaks in Tumalo Irrigation Project Reservoir

An investigation of the leaks in the reservoir of the Tumalo irrigation project will be undertaken within the next few weeks, according to Secretary McAllister of the State Desert Land Board, Salem, Ore. A bill appropriating \$10,000 for the investigation was passed by the legislature and provides that the board shall appoint two expert engineers, who, together with the manager of the project, shall make the investigation and make a report to the board. If they conclude that the leaks cannot be repaired, the reservoir will be abandoned, but if they can formulate a feasible plan for the repair of the leaks and its cost is within the legislative appropriation it will be adopted. Leaks were discovered in the big reservoir in 1915, and it has since been out of commission, although attempts were made to repair it.

Smoke-Abatement Ordinance in Cleveland Revised

The newly revised and supplemented smoke-abatement ordinance of Cleveland, approved by the acting Mayor March 2, contains provisions for a commissioner of smoke inspection in the Department of Public Safety. He must approve plans for the construction of new installations and of the reconstruction of old plants, but his approval does not exempt owners in case the plant should emit dense smoke for a period longer than six minutes in any one hour. Fines range from \$10 to \$100. Noxious fumes or gases from metallurgical furnaces, stills and galvanizing plants are declared to be a nuisance.

More Engineers Appointed to Officers' Reserve Corps Navy Department Announces Important Examination

(CONTINUED FROM PAGE 521)

N. J.; M. E. Pumphrey, Ill.; Herman Larsen, Wis.; William F. Barck, N. Y.; Albert Holmes, Washington, D. C.; Oliver G. Taylor, Washington, D. C.; Frank A. Danforth, Washington, D. C.; Charles A. Case, Kan.; Frank C. Dugan, Ohio; W. E. Stark, Ohio; R. W. P. LeBaron, Ill.; Alexander Kennedy, Jr., N. Y.; James M. Rawls, Washington, D. C.; A. H. Davison, N. Y.; G. B. McClary, Ill.

Due to the fact that about 900 applications have been received for the grade of major, it was necessary to reject about one-third of them or to commission the applicants in a lower grade. It has been finally decided to adopt the rule that no major would be commissioned under forty-five years of age. It was thought by the department that this rule would give the best results and cause the least dissatisfaction.

St. Paul Starts Work on Station

St. Paul, Minn., recently celebrated the beginning of work on the new \$11,000,000 union station to be erected by the St. Paul Union Depot Company.

Special attention is directed to the following civil service examinations to fill vacancies in the U. S. Navy Department, Bureau of Yards and Docks:

Assistant Civil Engineer.—Not less than six nor more than nine vacancies to be filled. Appointees are commissioned with the rank of lieutenant (junior grade) with pay and allowances approximating \$2500 a year. The highest rank in the Corps of Civil Engineers is rear admiral, carrying with it, including pay and allowances, a remuneration of approximately \$9500 a year.

The examination will be in two parts: (1) A preliminary, to determine the candidate's general fitness, based on his collegiate record, testimonials, statements of references and professional experience. Candidates will not be assembled for this examination, but will submit their papers by mail direct to the examining board in Washington; (2) a final, including an oral and written examination, to be held in Washington, D. C., and open only to those who have passed the preliminary examination. Candidates before the final examination will be examined as to physical fitness by a board of medical

officers of the U. S. Navy. If found to be physically unfit the candidate will not be further examined. The following are pre-requisites for consideration: No candidate over 26 years of age on Jan. 1, 1917, will be eligible for examination; the candidate must be an American citizen; must have received a degree from a college or university of recognized standing, showing that he has satisfactorily completed a course in engineering; must have had not less than 18 months' practical professional experience since graduation, and must be of good moral character and repute.

For further information address the Chief of Bureau of Yards and Docks, Navy Department, Washington, D. C.

Idaho to Spend \$2,720,000 on Road Construction

The Idaho Legislature recently passed a bill providing for a \$1,000,000-bond issue for good roads in the state. This act will make available for road construction during the next two years a grand total of \$2,720,000, of which \$1,000,000 will be raised by the state, \$1,250,000 by the counties, \$335,000 from the Federal Aid road act and \$135,000 from the Forest Service. E. M. Booth is state highway engineer.

New Highway Bridge First to Span Lower Columbia River



THE Interstate Bridge, connecting Portland, Ore., and Vancouver, Wash., recently opened, is the first bridge to carry traffic across the lower Columbia River. Its opening removes the last obstacle to the Pacific Highway, which has been blocked only at this one point from Mexico to Canada.

In addition to highway traffic, however, the bridge will carry six lines of rails to provide double tracks for both broad and narrow gage electric cars. Work on the bridge was started in March, 1915, and it was opened to traffic February, 1917. A complete description of the bridge appeared in the Engineering Record of July 8, 1916,

page 36. Harrington, Howard & Ash, of Kansas City, Mo., were the consulting engineers in charge of the design and construction. Contractors on the structure were the Pacific Bridge Company, U. S. Steel Products Company, Porter Brothers, Tacoma Dredging Company and Standard American Dredging Company.

U. S. to Investigate Fields in Russia and Far East

Russian and Far Eastern fields for American investments are to be investigated at once by the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce. A. W. Ferrin, president of the Moody Magazine & Book Company and editor of Moody's Magazine, has been appointed trade commissioner to make the investigation and will sail from San Francisco on April 30. In the meantime, he will visit some of the principal business centers in this country and consult with persons especially interested in the investigation.

Mr. Ferrin will include in his trip Japan, Russia, China, the Philippines, the Dutch, British and French East Indies, the Straits Settlement, Australia, New Zealand, Ceylon, India and East and South Africa. He will study investment opportunities in these countries and will report on financial conditions, banking, railroad and public utility, and other forms of finance, with particular reference to the extension of American foreign trade.

San Francisco Engineers Study Tactics

Since the Engineers' Corps of California has been discontinued, a group of young engineers in San Francisco has arranged to co-operate in studying subjects that would be particularly useful to engineers in time of war. The course of study has been outlined with the idea that what the engineers need is not training in military engineering so much as training in the tactical operations of warfare which would have a bearing on military engineering. The civilian engineer is equipped to carry out the engineering work proper, but would be at a disadvantage in providing adequate military protection during construction, and would not be familiar with the principles governing the purpose for which certain survey and construction work would be required.

Study Principles of Organization

As laid out, the course involves weekly meetings in preparation for which the students study the theory and principles of organization, the inter-relation existing from private to commander in field forces, the inter-relation between the different arms, preparation of records looking to the maintenance of communication and supply, and the analysis of field equipment. Map and patrolling problems are taken up, and, finally, a progressive problem involving practically all the instruction that precedes it is worked out.

This progressive problem, which is worked out by the class on a large scale wall map, is handled so as to bring out the definite strategy behind a movement involving engineer troops, outlines the grand tactics that lead to the

initiation of the movement, and develops in full the minor tactics with due regard to field service regulations of the various arms involved. This includes theoretical engagements, in which members of the class officer the forces on one side, and a referee announces decisions as to the success of the strategical moves and the operations of the enemy.

The course is planned to give the engineer a thorough grounding in subjects required in the examinations for the officers' reserve corps. At the same time it is laid out so as to make it of continuous interest, and of certain service to the engineer in time of war whether he takes the examinations or not. The work has been organized and directed by J. W. Swaren, of Hayward, Cal.

Move for Engineers' Building in Chicago

A home for all of the engineering societies in Chicago is the proposition which the Chicago Engineers' Club has under serious consideration. An inquiry sent to eleven societies brought favorable response from nine of the organizations, the inference being that, provided a definite and practical scheme were evolved by the Chicago Engineers' Club, the opportunity for negotiating for space would be welcomed. There is the possibility of augmenting the present quarters by purchasing adjacent property or by going to an entirely new site.

Hogs Will Eat Topeka Garbage

A scientific hog ranch, on which none but animals immunized against cholera are to be kept, is to be established to care for the garbage of Topeka, Kan. W. L. Porter, commissioner of parks and public property, writes that a contract to collect all the garbage free to the citizens and free to the city has been entered into. Collections will be made once a day all over the city from May 1 to Oct. 1, and for the colder six months once a day in the business districts and twice a week in the residential portion of the city.

Offer Prizes for Road Arguments

Prizes will be given in the State of Oregon for the best arguments favoring the adoption of the \$6,000,000 road bond issue to be voted upon in June. Each of the 36 counties in Oregon will have its own contest, which will be so arranged that one competition will be for the State at large, another will be confined to each particular county, another will be open to grammar school students, and another to high school students. Money for the prizes will be raised by popular subscription, and collected by the committee. Winning arguments will be offered to the press of the State for publication, and parts of the best essays will probably be included in the voter's pamphlet which will be issued by the State.

What Engineers and Contractors Are Doing

C. A. PECK, who was formerly in the employ of the Rivers, Harbors and Bridges Commission of Connecticut on the construction of the \$1,000,000 steamship terminal at New London, Conn., is now with C. A. Tinker of Stafford Springs, Conn., as construction engineer engaged in mill building and power-plant installation. Mr. Peck was employed by the American Telephone & Telegraph Company as inspector on the underground installation from Washington to Boston. Since 1912 he has been in the employ of the state of Connecticut and for a year and a half on the erection of a highway drawbridge over the Connecticut River at East Haddam.

P. D. VAN VLIET has been appointed publicity manager for the Universal Portland Cement Company, with whom he has been employed seven years. After graduation from Cornell University as a civil engineer, Mr. Van Vliet was with the Arnold Company, Chicago, in hydroelectric and irrigation design until 1910.

F. CLARKE DUGAN has resigned from the Division of Sewerage, Cincinnati, to become assistant engineer with William G. Clark, consulting engineer, Toledo, Ohio. Mr. Dugan was graduated from the University of Kentucky in 1910 and was connected with the Sewerage Commission of Louisville, Ky., until 1913.

ALGER & KRAUS, contracting engineers, Guardian Building, Cleveland, has recently been organized by Ralph J. Alger and Arthur A. Kraus. Both Mr. Alger and Mr. Kraus were resident engineers for the New York Continental Jewell Filtration Company. Mr. Kraus has just been in charge of the erection of the Kenosha (Wis.) filter plant, which is practically completed, while Mr. Alger recently completed a plant for the Goodyear Tire & Rubber Company at Akron, Ohio. Previously both members of the firm were engaged on other purification plants. Mr. Kraus is a graduate of New York University, while Mr. Alger was graduated from both Harvard and Massachusetts Institute of Technology.

L. D. LEA, formerly city engineer of Lead, S. D., has resigned to go with the Export Service Corporation, First National Bank Building, Chicago, as chief engineer. He is at present planning construction work to be undertaken in Colombia, S. A.

S. BENSON, of Portland, Ore., has been elected chairman of the Oregon State Highway Commission.

SAMUEL D. WILLIAMS, division engineer of the Michigan Central Railroad, with headquarters at St. Thomas, Ont., has been transferred to the company's main office at Detroit.

H. McL. HARDING, consulting terminal engineer of New York City, has been appointed consulting terminal expert in connection with the building of a chain of terminals to be located at various cities along the New York State barge canal. Mr. Harding is president of the Society of Terminal Engineers, recently organized in New York City.

S. C. PRICE has been appointed city engineer of Goldendale, Wash.

C. S. BILYEAU, formerly connected with Hildreth & Company, engineers, of New York City, recently became associated with Gulick-Henderson and will be located in their general office in New York City.

HARRISON W. CRAVER, chief librarian of the Carnegie Library of Pittsburgh since 1908, has resigned to become director of the library of the United Engineering Societies of New York City. His new position will put him in direction of what is believed to be the largest engineering library in the world, with approximately 150,000 volumes on technological subjects.

G. E. STELLER has resigned from the inventory department of the Southern California Edison Company to become chief draftsman for the Southern Counties Gas Company of California.

C. C. COOK, division engineer of the Pittsburgh division of the Baltimore & Ohio Railroad, at Pittsburgh, has been appointed district engineer of maintenance of way of the West Virginia district, at Wheeling, W. Va. Mr. Cook entered the service of the Baltimore & Ohio Railroad as an axeman and was subsequently engineer, chief draftsman and division engineer. He was promoted to division engineer at Philadelphia in 1911 and was transferred to Pittsburgh in 1913.

BENJAMIN F. WOOD, for sixteen years electrical engineer with the Pennsylvania Railroad and for the last three years vice-president and chief engineer of the United Gas & Electric Engineering Corporation, has organized B. F. Wood Engineers, Inc., Woolworth Building, New York City, to investigate, design, construct and supervise engineering works in power development, transmission, railroad electrification, electric railways, lighting systems and industrial plants.

F. S. SMALL has resigned as acting district engineer in the Canadian Department of Public Works, in charge of the St. John River district. Mr. Small joined the department in June, 1914, as assistant engineer and became acting district engineer Jan. 1, 1916.

R. L. SLOCUM has been made assistant superintendent of the Universal Portland Cement Company's mill at Universal, Pa. Mr. Slocum was graduated from Pennsylvania State College in 1905. He spent two years in construction for the Homestead Steel Works and began work in the spring of 1907 for the Universal Portland Cement Company in charge of building

construction and the installation of machinery at Universal. He is now in charge of plant operation and management under the superintendent.

JEROME NEWMAN, formerly chief engineer of the California State Board of Harbor Commissioners, has opened an office as consulting engineer at 260 California Street, San Francisco. Special attention will be given, it is announced, to valuation and cost of service in connection with public utilities.

ROBERT ISHAM RANDOLPH, consulting engineer, on March 29 addressed the membership conference of the Chicago Association of Commerce on "The Business Man and the Function of the Consulting Engineer."

F. D. STANLEY and J. W. BAILEY have formed a partnership with offices in the Citizens' National Bank Building, Baker, Ore., to conduct a general engineering business. Mr. Stanley has been engaged in mining engineering and Mr. Bailey was formerly city engineer of Baker, Ore.

H. R. GERRARD, Alberni, B. C., has been appointed city engineer of Duncan, Vancouver Island.

MELVIN O. SYLIASSEN, structural engineer, and G. R. Hawes, formerly chief draftsman, Chicago, Milwaukee & St. Paul Railway, both of Seattle, Wash., have accepted positions under V. D. Simons, industrial engineer, Vancouver, B. C., and will engage in the construction of pulp and paper mills throughout the province.

C. C. JONES, formerly in the engineering department of the Chicago, Milwaukee & St. Paul Railway, Chicago, has entered the firm of Jones & Bohmke, engineers and contractors, Hutchinson, Kan.

ERWIN O. HATHAWAY, recently appointed district engineer for the fourth district of the U. S. Office of Public Roads, has established headquarters in the New Post Office Building at Minneapolis, Minn. Mr. Hathaway has been for nearly four years senior highway engineer in the Office of Public Roads, previous to which time he was for eight years division engineer in the New Hampshire Highway Department and for about four years city engineer of Nashua, N. H.

S. A. JUDSON has resigned from the topographic branch of the U. S. Geological Survey to engage in topographic engineering and oil geology for F. Julius Fohs, consulting oil geologist, Gallais Building, Tulsa, Okla.

M. H. DOUGHTY has been appointed assistant to the chief engineer of Delaware, Lackawanna & Western Railroad, Hoboken, N. J., having charge of the general drafting office and of valuation.

H. S. OWEN has accepted the position of field engineer for the Kansas City office of the Portland Cement Association, with headquarters in St.

Louis, Mo. Mr. Owen was formerly principal assistant to the chief engineer of construction, Department of Streets and Sewers of St. Louis, Mo.

P. W. CLANCY has been appointed the Nebraska representative of the Kansas City office of the Portland Cement Association. Mr. Clancy was formerly engaged in municipal work and was resident engineer on construction for the Canadian Northern Railway and Union Pacific Railway.

C. I. FELPS has been appointed field engineer for the Kansas City office of the Portland Cement Association, with headquarters in Wichita, Kan. Mr. Felps was formerly with the Kansas State Highway Department and was recently with the bridge department of the Kansas City Terminal Railway Company.

M. E. REEDY, formerly assistant engineer with the U. S. Reclamation Service in charge of the location and construction of the East Park feed canal of the Orland project, has been made assistant engineer in the hydraulic department of the California State Railroad Commission. For a short period after leaving the reclamation service Mr. Reedy was in the design department of the Chicago, Milwaukee & St. Paul Railway at Chicago.

A. N. JOHNSON, consulting highway engineer of the Portland Cement Association, has been appointed on the committee of the American Association of State Highway Officials which is collecting information as to changes which the States expect to make in their highway laws. Many States are at present planning revision or amendment of such laws so that they may take advantage of government aid in road improvements.

Obituary Notes

JOHN KASSON HOWE, dredge engineer of the Osgood Dredge Company, Albany, N. Y., and the Osgood Company, Marion, Ohio, died March 4. Mr. Howe organized the Osgood Dredge Company in 1883. This company obtained the original patents on the boom-type dredge. He was secretary and treasurer of the Osgood Dredge Company until its consolidation with the Osgood Company, when he became a director in the latter company and its Eastern sales representative.

J. E. GARDNER, city engineer of Napa, Cal., and formerly construction engineer for many years with the Southern Pacific Company, died March 13.

ELISHA K. GREEN, who was prominent in the early development of a water system for Los Angeles, died recently in that city at the age of 78.

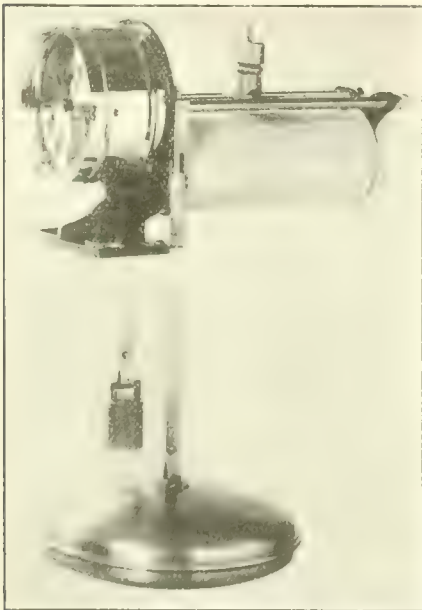
Develop Walking Dredge for Light-Weight Road Pump Is Mounted Ditch Work

For contractors engaged in drainage and ditching work the Bay City Dredge Works, of Bay City, Mich., has developed a new type of land dredge. This is a walking dredge using a series of feet in place of the steel trucks and sectional track for moving the dredge ahead on the work.

The builders state that this walking dredge will work successfully over rough, marshy or slippery ground, that no track, skids or extra planking is required and that the dredge will be found particularly desirable in drainage districts where the yardage per station is small. The dredge was given a tryout in Minnesota during 1916.

Stage Register Developed for Irrigation

A seven-day accurate, compact register has been developed by W. & L. E. Gurley, Troy, N. Y., for use in connection with irrigation and sewage-disposal weirs. It is stated that its construction is such that no lost motion will develop from continuous service and that it can be operated with min-

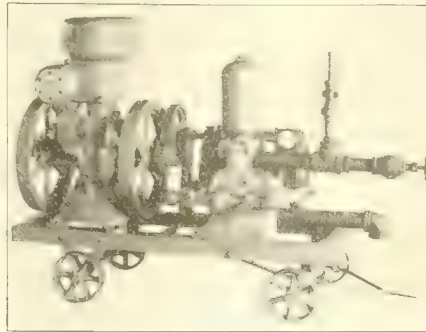


WATER STAGE REGISTER MAKES SEVEN-DAY GRAPH IN 1-FOOT RANGE

imum care and expense. It gives a record to 0.01 ft. on a ruled sheet, the rulings covering a space of 12 x 7½ in. The vertical rulings indicate the water stage for range of either 1 or 2 ft., as desired. The time scale is 1 in. horizontally for each 24 hours.

If desired, the feed screws on the register can be changed so that the pencil will travel 8 in. in 24 hours, on sheets ruled 12 lines to the inch. Each space thus represents 15 minutes. This will necessitate changing the sheet every day. This register, which is furnished with a float 10 in. in diameter, is sold for \$65 or \$75, depending on whether the range is for 1 or 2 ft.

A new light, high-pressure pump delivering 33 gal. per minute under a head of 270 ft. has been put on the market for use in construction road work. For this purpose it is mounted as shown in the photograph. At capac-



MOUNTED PUMP OUTFIT FOR ROAD WORK GIVES HIGH PRESSURE

ities of from 32 to 110 gal. per minute it is claimed it will deliver water a distance of 3 miles. The valves are of the spinning type, self-cleaning and self-grinding. It is a single cylinder, double-acting pump built in six sizes varying from 3 x 5 in. to 6 x 6 in. The weight of the 5 x 5-in. size, with 3-hp. engine, is 1100 lb. The outfit is built by the Whitman Agricultural Company, St. Louis.

Trade Notes

Permutit Company, 30 East Forty-second Street, New York City, announces that Cass L. Kennicott, expert in water softening and filtration, has become associated with the company in charge of the Chicago office, 208 South La Salle Street, Chicago.

Metropolitan Paving Brick Company, of Canton, Ohio, announces the purchase of the brick interests of the Bessemer Limestone Company, of Youngstown, Ohio. By the terms of the purchase the Metropolitan company has acquired the brick kilns of the Bessemer company, which are located at Bessemer, Pa., including several hundred acres of paving-brick shale. The general office of the company will be at Canton, Ohio, as in the past.

Pulsometer Steam Pump Company, Chicago office, has been changed from the Lytton Building to 415 South Dearborn Street, Old Colony Building.

Chain Belt Company has retained John M. Trevor, 30 Church Street, New York City, to sell its Rex concrete mixer.

Berger Manufacturing Company has recently made the following appointments: Division of building material, R. W. VanHorn; efficiency engineer, Norman A. Hill; sidewalk-light department, P. V. Stonerod, and chief engineer of sales department, A. H. Bromley, Jr.

Irwin Newman, engineer, of Chicago, Ill., has opened an office at 945 First National Bank Building, where he is representing the Reeves-Cubberly Engine Company, of Trenton, N. J., and the D'Olier Centrifugal Pump & Machine Company, of Philadelphia, Pa.

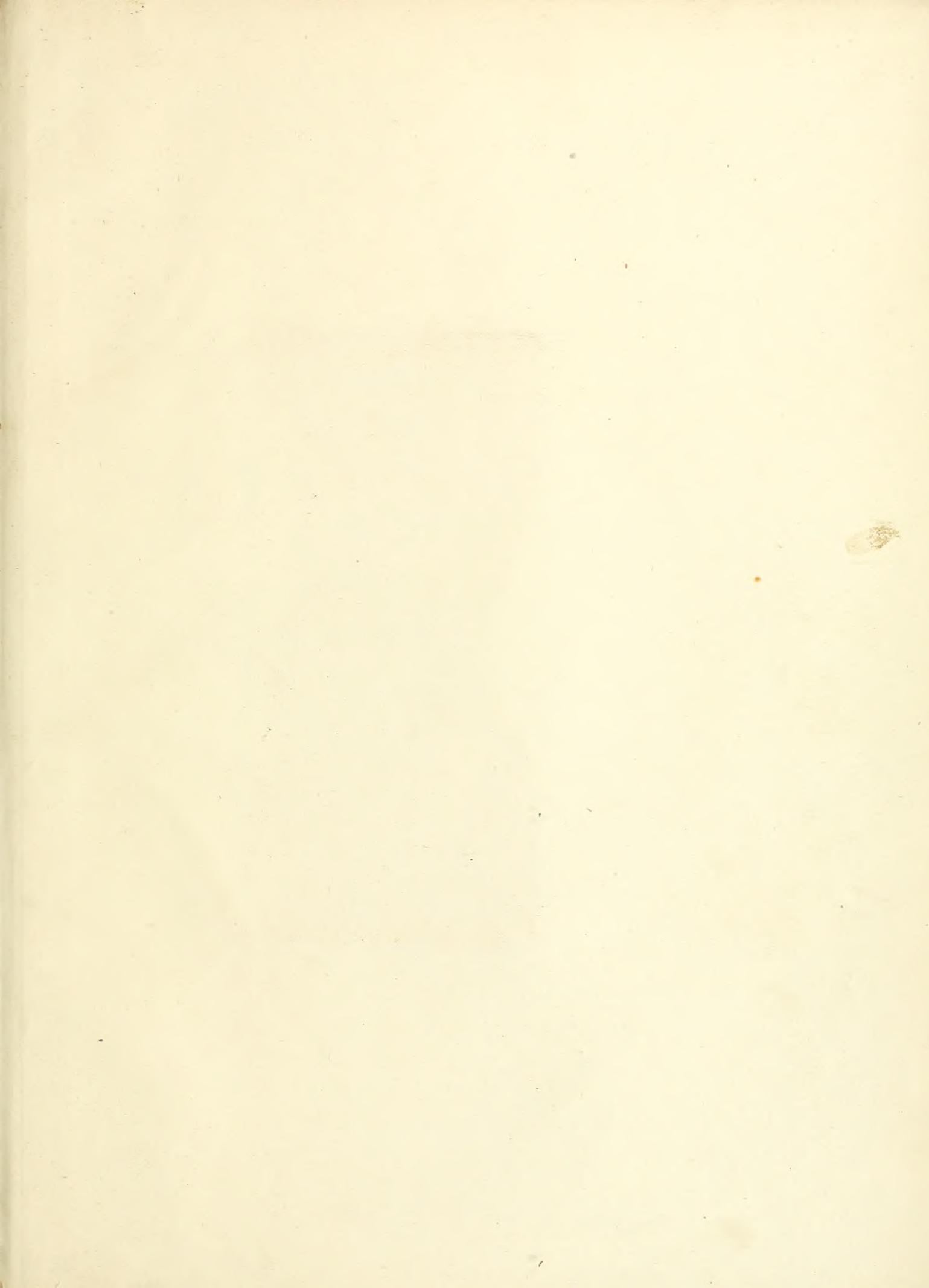
Norcross Brothers Company, now starting on its fifty-second year of continuous service has reorganized. O. W. Norcross is chairman and E. F. Jones is president of board of directors. The offices are in Worcester and Boston, Mass.; New York City, Providence, R. I., and Montreal, Que.

Alaska Railroad Commission has opened offices in San Francisco. G. H. Gamble, formerly with the Northwestern Pacific Railroad in San Francisco, is in charge as resident purchasing agent.

Turner Construction Company announces the removal of its New York offices from 11 Broadway to 244 Madison Avenue.

The Clinton Wire Cloth Company, Boston, Mass., is being reorganized. Mr. Charles F. Fairbanks, who has been treasurer of the company, will remain in the same capacity in the new organization, representing the financial interests which have taken over the property. Clinton products have been on the market since 1856 and the structural materials now made include wire lath of various types and electrically-welded fabric for reinforcing concrete. As part of the reorganization, a new department to be known as the Structural Products Department, and in charge of Royall D. Bradbury, will be formed. Its object will be to extend and broaden the field for the company's structural materials and to develop and perfect new products. In the reorganization, moreover, the selling arrangements of the company will be completely changed. Albert Oliver & Son, Inc., will take over the selling for the entire territory east of the Rocky Mountains and have engaged the entire floor of the Flatiron Building, New York, for their offices. The territory is to be covered as rapidly and efficiently as possible, pushing particularly electrically welded fabric for the reinforcement of concrete roads.

The Hercules Cement Corporation, of Philadelphia, Pa. (mill at Stockertown, Pa.), has taken offices at 30 East Forty-second Street, New York City, which will serve as headquarters for its sales department. E. B. Goode, Jr., who for the last four years has been metropolitan district sales manager for the Lehigh Portland Cement Company, has been appointed sales manager of the corporation, and will take up the duties of that office at once. He will commence his organization work immediately and will be established in his new headquarters by April 1. Mr. Goode has been active in the building material line for eleven years, having been with the Wotherspoon Plaster Mills, Inc., before entering the services of the Lehigh Portland Cement Company.



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